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HIGH-VOLTAGE CONDENSERS.

The static condenser, as it is called, is one of the most interesting physical devices. It is one contrivance which seems to point to a physical existence of electricity. Electrical energy is most usually made apparent by its transfer from point to point. Here it seems to be tied down, and yet it imparts to charged bodies properties which they did not before possess.

In practice, however, but little use has been made of the static condenser, although its properties would be advantageous for many purposes. It is true that, to a limited degree, the condenser has been used in connection with induction motors and other apparatus having an undesirable amount of self-induction, but it has never come into what may be called general use. There are several reasons for this, the most important of which is that a condenser of sufficient capacity to be of practical value is bulky and expensive. Moreover, it has the reputation of being unreliable and of breaking down for slight causes; and it is repaired with difficulty.

In the issue of the ELECTRICAL REVIEW for February 16 an ingenious type of condenser was described, the design of which is intended to overcome these objections. In the first place the capacity of the condenser is increased, not by increasing the number and size of the elements, but by decreasing the dielectric thickness. The same method of procedure may be followed in condensers of every type, but it involves the objection that a decrease in the dielectric thickness decreases the dielectric strength and reduces the voltage for which the condenser is suitable. The strain on the dielectric, however, comes mainly at the edge of the metal coating, so that by increasing the thickness of the dielectric at this part, but leaving it thin elsewhere, an increased capacity may be secured without lowering the safe voltage. This method is not practicable for the ordinary condenser—that is to say, one in which flat metal sheets are interposed between the sheets of dielectric; but it is easily applied in the form described in the article referred to. Here the elementary condensers, corresponding to two metal sheets separated by a sheet of dielectric, are in the form of metallic coatings on a glass tube. This tube is closed at one end, contracted to a narrow neck with thickened walls at the other, and has a metallic coating inside and out. Thus decreased dielectric thickness and increased capacity is accompanied by no diminution of the limiting dielectric strength.

Another advantage of this method of construction is the facility with which the separate elements may be cooled. Condensers, as usually employed for physical experiments, cause no appreciable loss of energy. When, however, used for high press-

ures and continuously, a loss does take place, and unless the heat thus developed be dissipated the condenser will be destroyed. This is accomplished easily by submerging each of the condenser tubes in oil. Condensers of this form, it is said, are suitable for voltages up to 40,000 or more.

This new form of condenser is a good illustration of what may occasionally be accomplished by a radical departure from standard forms which from long use have become more or less fixed.

THE FLICKER PHOTOMETER.

One of the more recent methods of comparing sources of light is that employed with the flicker photometer. Although devised some time ago, this instrument has taken on a new importance within recent years because of the variety of sources of light, differing in quality, now available.

The most usual forms of photometer are based upon a comparison of illuminated surfaces. Two white surfaces are lighted, each by one of the sources of light, and the observer judges when the illuminations are equal. To secure accuracy the two fields of vision should be brought as close together as possible, and there should be no distinct dividing line other than that due to a difference in the intensity of illumination upon the two. There are several ways of securing this effect. In some instruments the two fields are merely placed side by side. In some the light from the two sources is mixed as, for instance, in the Bunsen and Joly photometers; but in all such instruments the final adjustment depends upon the ability of the eye to judge equality. There have been attempts to replace this principle by others depending upon physical effects, and not physiological. Such, for example, is the selenium photometer, which depends on balancing the effects of light upon the resistances of two selenium elements. This method is legitimate only in special investigations, because the relation between the physiological effect of the light upon the eye and the change in the resistance of the selenium is not yet known. Besides, there are other interfering factors, such as hysteresis or fatigue, which complicate the problem.

A third method is that utilized in the flicker photometer. Here, instead of comparing two or more surfaces illuminated by the two sources, and judging the equality of the illuminations, the surfaces illuminated by the two sources are brought alternately into the field of vision, so that the eye sees first one and then the other. The eye is then required to judge, not between two surfaces seen simultaneously, but whether the illumination of the field of vision varies. This is determined by causing the two fields to succeed each other somewhat rapidly, so as to produce an apparently flickering field. The intensities of illumination are then varied until this flicker disappears, when equality is supposed to exist. It is to be noticed here that this method of comparing lights differs greatly from the other. In the one case the eye must decide when the stimulation upon two parts of the retina are equal; in the other, the stimulation of the retina is everywhere equal, and the observer determines merely when his eye ceases to try to follow the variations in this stimulation. It is very probable that the sensitiveness of different observers to this effect will be different, just as one may have a better judgment for equality of illumination than the other.

If the lights from the two sources have the same quality or tint there is not much difficulty in obtaining a satisfactory comparison with any photometer. It is only when the quality differs that much difficulty is met. In such cases the inexperienced observer is utterly at a loss, and can not tell when the illuminations are equal. With the flicker photometer he does not meet this difficulty, because the effects of the two lights are superposed. He is not called upon to judge of intensity of illumination or of color, but merely to notice when the sensation of flickering disappears. There is not much difficulty in doing this, but it may be questioned whether the same observer would have obtained the same results if he had compared the two illuminants by some other method. In other words, is he judging the effect of illumination or some other effect?

The question raised here is whether the sensation from the retina is proportional to the luminous radiations, or whether there is not some more complicated action. As was pointed out by Dr. C. P. Steinmetz at a recent meeting of the Illuminating Engineering Society, red light easily produces that effect known as the after-image, while green light does not. If, then, in comparing two illuminations, one of which is distinctly redder than the other, the effect of the former is more persistent than that of the latter, it seems likely that the red light, measured with a flicker photometer, will be given a rating higher than it would get if there were no opportunity for such effect, as would be the case when looking at two steadily illuminated fields. As yet, it has not been shown that the flicker photometer removes all the difficulties encountered in comparing illuminants which give lights differing in color.

This raises again the question whether it is legitimate to make comparison between lights of different colors. Different colors produce different sensations; otherwise the color difference would not be perceived; and is it possible to make a comparison between these different sensations? One may, of course, judge between the intensities of two similar sensations, but the other comparison between different things is more like trying to judge the relative intensities of two different tests. The proper way to make such a comparison would, of course, be to decide when the eye can see with equal distinctness by means of the different-colored lights; but here again that old difficulty known as the Purkinje effect comes in, so that satisfactory comparisons must be made under specified conditions; otherwise the red light will be given the advantage for intense illuminations, while the green and blue will have a rating higher where it is less intense. It is certain that this phenomenon affects the action of the photometer, a point which was brought out by Mr. P. S. Millar at the meeting of the Illuminating Engineering Society referred to above.

There are other undesirable features of the flicker photometer, some of which are discussed in an interesting article by

J. S. Dow, a brief abstract of which is given elsewhere in this issue. One of these is the fatiguing action caused by the flicker, which is certainly most undesirable and sufficiently objectionable to condemn this instrument for general purposes.

As has been said before, there can be no comparison of lights of different colors in the ordinary sense. The scientific method, of course, would be to resolve each light into its spectrum, and then compare the different parts of these; but even were this done, who is to decide what weights are to be given to the different portions of the spectrum? Practically, however, there is not so much difficulty, because what is desired is not so much a comparison of different sources of light as a knowledge of the effectiveness of each. When it is known that the incandescent lamp for certain purposes gives satisfactory results with a certain intensity of illumination; that the luminous arc is equally satisfactory under certain other conditions, and that the mercury arc may be used effectively for such and such purposes, there is no need to rate each one in candle-power measured by comparison with a certain arbitrary standard. In other words, what is needed is the results of actual trials. In fact, this is the more necessary because there are other factors entering into illumination problems which can not be taken into consideration when comparing lamps in the laboratory. When developing a source of light it is, of course, necessary to make comparative measurement. There is no difficulty in doing this. But in actual problems it is the final effect which is sought; and since local conditions may make it necessary to vary the intensity of illumination several times, depending upon the quality of the light employed, accurate ratings of these various sources in terms of an arbitrary standard have but little value.

THE ENGLISH CHANNEL TUNNEL.

An interesting topic of discussion in the engineering world is the revival of the proposal to drive a railway tunnel under the English channel from England to France. The idea is an old one, but for several reasons has never been seriously considered. Now, however, the electric locomotive offers a solution of the problem and makes it practicable to draw trains through a tunnel over twenty miles in length, placed under the sea where ventilating shafts can not be constructed. The plan is one of considerable magnitude, involving as it does a twenty-mile tunnel, with approaches some thirty miles long at each end. But there are other engineering undertakings now being carried on which, while different in character, involve a considerably greater amount of work, and the estimated cost of which is much greater than that of the channel tunnel, which, it is expected, would cost only about $30,000,000.

It may safely be said that for the first time we are now in a position to undertake such an imposing work, but it does not follow that because the construction may be undertaken with confidence that this will be the outcome of the present talk. Now that we are confident of the engineering practicability of the scheme, the main question is a financial one; and even here it is not a question of the ability to raise the money, but whether the tunnel would prove a profitable investment.

SMALL ELECTRICAL DEVICES NEED CONSIDERATION.

A recent disastrous fire—disastrous in that it caused the destruction of a magnificent home—was caused, it is said, by the negligence of a servant using an electric flat-iron. Whether this statement is true or not is immaterial now, but in view of the charge it seems well to point out that small electrical household devices need a certain amount of consideration. This statement is true of any utensil in which heat is developed, but the public seems to think that because it sees no flame there is no possibility of fire. No servant, however thoughtless, would throw a towel around a lighted gas lamp; yet how many appreciate the possibility of a fire if the same treatment be applied to an incandescent lamp? It is not realized that an incandescent lamp, although it gives out considerably less heat than an oil or gas lamp when giving the same amount of light, still does set free heat in large quantities; in fact, the amount of heat given out by an incandescent lamp is equivalent to about one-twelfth of a horse-power. This statement will not convey much meaning to the uninitiated, though perhaps it may be impressive, but a more impressive way of illustrating the point is to wrap a towel around an incandescent lamp and see what happens. When the heat is thus confined, it will not only set fire to the wrapping, but may soften and melt the glass bulb. This fact is well known, and the insurance rules provide for it. In one sense of the word it constitutes a danger, but the risk from this source is comparatively small, since it is not customary to hang clothing on electric lamps; it is practically negligible in all properly-cared-for homes.

This is true of the incandescent lamp, and is true of any heating device. A curling iron, if left in circuit and wrapped up, a chafing dish if completely enclosed, or a flat-iron if left in circuit upon inflammable material, may start a fire. It is the function of the electric current to develop heat in the flat-iron. The amount of heat thus developed must be considerable, as in the process of ironing a good deal of water must be converted into steam. If the heater be left in action, but the iron be placed so that it can not get rid of this heat, the temperature must necessarily rise. It is possible to obtain some degree of protection against fire in such cases by introducing a thermostat in the heater, but this does not entirely obviate the danger of fire. Also, it is easy to arrange the iron so that the electric current will be cut off whenever it is released from the hand; but here again there is a possibility that the automatic switch may get out of order. The only sensible thing to do is never to leave the iron in a position where it can start a fire. In general the danger is slight, but it should nevertheless be realized.

There are many other little electrical devices which are exceedingly safe when compared with other apparatus for performing the same operations, but it should never for a moment be forgotten that an electrical current represents energy; that all forms of energy tend to become heat, and that heat, if confined, may start a fire. Electrical apparatus as a class introduces less danger than any other, but it may become dangerous if abused.

The Instructive Value of Working Exhibits.

The increasing power and complexity of cars recently built for rapid-transit service, says the *Electric Railway Review*, imposes a burden of no little responsibility upon those charged with the instruction of train and car-service men. For several years trainmen, and it is suggested that similar advantages should be given shopmen, have been instructed in their duties by supplementing oral or printed teaching with practical study of actual car equipment. A familiar feature of the latter method is the provision of schoolrooms fitted with controllers, brake-valves and cylinders, train lines, signal lanterns and illustrations of detail parts of the rolling stock. The addition of air-compressor outfits and working control circuits makes possible better teaching than was feasible without the vital stimulus of using power in the concrete. For this reason the modern trainmen's school, when equipped with skeleton cars and complete electrical apparatus, becomes a most efficient factor in preparing men for actual service. Of course, it is a mistake to assume that a new man placed in the car service has little more to learn after his two or three weeks of preliminary instruction. In the exacting routine of platform work new men often need friendly encouragement as the mastery of the equipment with respect to locating troubles on the road comes only with experience.

There appears to be no single part of the car equipment that all new men find especially hard to understand. With some new motormen the fundamental principles of the brake-valve are hard to grasp; with others, the understanding of the contactor, reverser or master-controller wiring may be a stumbling block. Much can be done to aid in the explanation of these points by exhibiting diagrams of circuits clearly drawn on a large scale and by including as a part of the teaching equipment sections of the braking apparatus.

The Boston Elevated Railway Company has gone even farther than to provide dummy cars with actual equipment in its trainmen's school. A special blackboard with sketches of the main motor-circuits, resistances, circuit-breaker, fuse and contactors painted upon it is mounted behind the corresponding groups of equipment on an instruction car. In each circuit on the drawing is inserted an incandescent lamp, which automatically lights whenever the current flows through the corresponding circuit on the dummy train. The change from series to parallel can plainly be seen, as well as the flow of current in the reverse circuit.

There is no question that the use of the lamps helps the men materially in understanding the circuit changes, and the scheme is a simple one which easily could be adapted for use in less elaborately equipped schools. The great point to be remembered in work of this nature is that electrical conceptions quite probably are foreign to the minds of applicants for train-service positions.

A large wall-drawing of the electro-pneumatic brake system which is used on the later type of cars has been found to be an effective aid to instruction. The valve handles on the drawing are made of celluloid cut to the proper shape and pivoted. All the other movable valves of the instruction equipment as well as the brake piston rod and rotating contacts are constructed of stiff pasteboard, so that the exact function of each part can be seen.

Such refinements may be considered by some as too elaborate, but when we consider the relative importance of high-class trainmen, well acquainted with the cars which they operate, it is easily seen that facilities for careful and thorough instruction are excellent investments.

New York Electrical Society.

The 265th meeting of the New York Electrical Society will be held in the new Engineering Societies Building, 29 West Thirty-ninth street, in No. 2 Assembly Room, on the fifth floor, Wednesday, February 27, at 8 P. M.

Professor Harold B. Smith, of the Worcester Polytechnic Institute, Worcester, Mass., will deliver an address on "Power Transmission Voltages of To-day and To-morrow."

Mr. Smith will discuss some of the problems which have been solved to make possible the present transmission voltages and will outline some of the difficulties remaining for solution before higher voltages can be employed. Some of the factors which enter into successful and economical power transmission at high voltages will be presented and some attempt made to indicate the direction and probable future development of this line of work.

The following members were elected at the last meeting: John W. Brooks, Solvay, N. Y.; Sydney F. Weston, 44 East Twenty-third street, New York city; Edward H. Waldo, Crocker-Wheeler Company, Ampere, N. J.; F. P. Thorp, 52 William street, New York city; F. H. Leonard, Jr., 52 William street, New York city; Nathan Fleischer, 52 William street, New York city; Albert C. Boeri, 26 Cortlandt street, New York city; Aldred K. Warren, 554 West 113th street, New York city; Chas. H. Hadlock, 15 Dey street, New York city; Kingsley G. Martin, 40 Morningside avenue, New York city.

Disaster to Electric Train on the New York Central.

On Saturday, February 16, a fast local train on the Harlem division of the New York Central & Hudson River Railroad left the tracks, resulting in the killing of twenty-two passengers and the injuring, more or less severely, of probably a hundred others. At the present time a rigid enquiry is being made into the cause of the disaster. It is known that the train, which was drawn by two electric locomotives of the new type just adopted by the road, was proceeding at its schedule speed of forty-five or fifty miles an hour when it struck a slight curve, resulting in the derailment. Investigations made so far have demonstrated that the roadbed and curve were in excellent condition, and the tangent such that an ordinary train could have proceeded with absolute safety at a much higher rate than that at which the wrecked train is supposed to have been running. It has also been shown that the derailment could hardly have been caused by a spreading of the rails, and it is stated that the weight of the locomotives was not sufficient to have caused any spreading at the curve. It is very likely that the enquiry which is now going on will demonstrate that the accident was the result of some unforeseen mechanical defect in part of the rolling stock, which, together with the curve and the speed at which the train was proceeding, culminated in the present disaster.

Meeting of American Institute of Electrical Engineers.

The 215th meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineers' Building, 33 West Thirty-ninth street, New York city, on Friday, March 1, 1907, at eight o'clock, P. M. The following papers will be presented and discussed:

"Alternating-Current Electrolysis," by J. L. R. Hayden, of Schenectady, N. Y.

"Electrolytic Corrosion of Iron and Steel in Concrete," by A. A. Knudson, of New York, N. Y.

"Some Theoretical Notes on the Reduction of Earth Currents from Electric Railway System by Means of Negative Feeders," by George I. Rhodes, of New York, N. Y.

The Hydroelectric Plant of the Utica Gas and Electric Company.

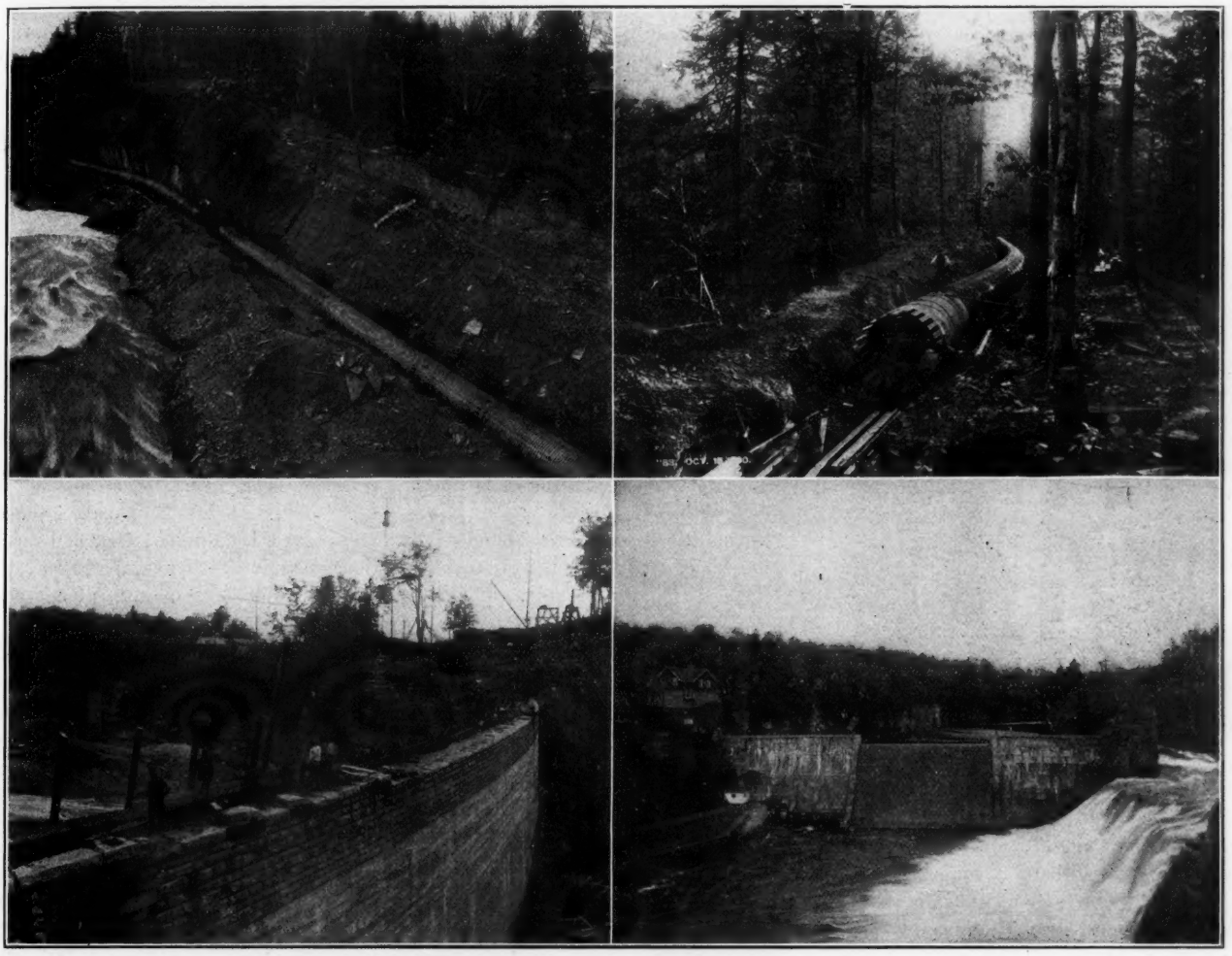
THE power station of the Utica Gas and Electric Company, Utica, N. Y., is located near the village of Trenton Falls, Oneida county, N. Y., on West Canada creek, one of the two streams draining the Canada lakes in the Adirondack mountains, and flowing into the Mohawk river at Herkimer, N. Y. The other stream, East Canada creek, empties into the Mohawk at East creek. Near the village of Trenton Falls, West Canada creek has a drop in head of nearly three hundred feet in less than a mile. The drainage area above Trenton Falls is 375 square miles, mainly Adirondack forest lands and lakes in a region of heavy annual rainfall.

The dam is 300 feet long, and sixty feet high, built of concrete, and falling across the creek on the arc of a circle with a radius of 800 feet. There are built into the bottom of the dam eight sixty-inch cast-iron pipes, two for supplying the present pipe-line, two for an extra pipe-line when the power-house extensions make this necessary and four as additions to the waste-weirs for carrying off excess water during floods. Each pipe is furnished with cast-iron sluice-gates, with bronze guides, and operated from the top of the dam. There are two flood-weirs. One is built on a rock shelf on the east bank of the stream close by and at right angles to the dam; the other waste-weir forms a part of the dam proper. The first weir is 160 feet long and the crest is nine feet lower than the top of the dam coping. The crest of the other weir is two feet higher and it has a length of 100 feet. At flood time the excess water runs off through the rock cut around the dam to the lower creek until the weir is submerged two feet, when the water will also flow over the second spillway. Provision is made for flash-boards on the rock-cut weir so that it may be raised two feet in dry weather.

Trouble from anchor ice has been eliminated by this construction. The ice does not sink to the point from where the outlets take off the water, and the lower crest of the spillway at the east bank creates a strong current which carries the anchor ice around the end of the dam and also away from the pipe-line intake.

Both the dam and the weir on the dam are capped with a heavy doweled stone coping and wing walls are constructed on the down-stream face of the dam to protect the face of the dam from injury by debris during heavy floods.

A cast-iron Y-piece sixty inches by sixty inches by eighty-four inches connects the



HYDROELECTRIC PLANT OF THE UTICA GAS AND ELECTRIC COMPANY. 1 AND 2.—WOODEN STAVE PIPE-LINE UNDER CONSTRUCTION. 3.—DAM UNDER CONSTRUCTION. 4.—DAM, SHOWING WASTE-WEIR ON DAM, WATER DIVERSION THROUGH ROCK CUT FROM WASTE-WEIR ABOVE, WASTE OUTLETS FOR EXTRA HIGH WATER AND GATE-HOUSE.

two sixty-inch pipes in the dam to an eighty-four-inch conduit which carries the water from the dam site to the turbines, over a distance of about 3,700 feet.

For the greater part of its length (about 2,900 feet) the conduit is formed of twenty Texas pine staves, each two and three-eighths inches thick, sawed on radial lines, making up the circumference of eighty-four inches. The staves are bound together and held in position by round iron bands. The steel pipe (about 800 feet long) varies in thickness of plates from three-eighths inch to five-eighths inch. The pipe is built up with lapped joints, the longitudinal laps double riveted and the circumferential laps single riveted. Where three-eighth-inch plates are used the pipe is stiffened with angle-irons.

The grade of the wooden stave pipe is

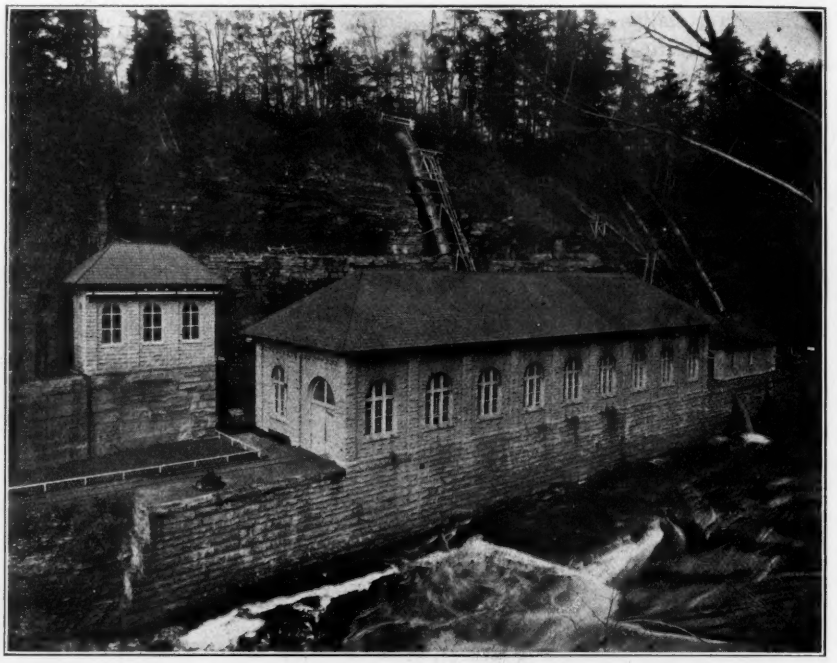
HYDROELECTRIC PLANT OF THE UTICA GAS AND ELECTRIC COMPANY—VIEW OF STAND-PIPE ON CLIFF ABOVE POWER-HOUSE.

winding and slightly descending; but from the point where it joins the steel pipe the descent is more pronounced and the line is almost straight to a point where it joins a stand-pipe 180 feet high and eighty-four inches in diameter. This stand-pipe is twenty feet higher than the dam, is covered with a shingled casing and is topped off with a cupola.

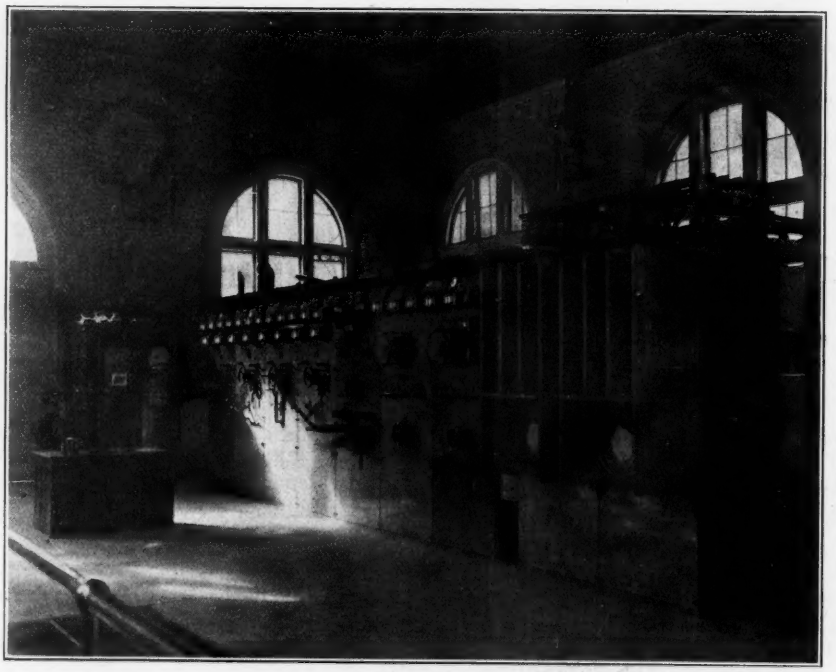
After passing the stand-pipe the pipe-line is carried down the cliff to a reservoir 125 feet below the top of the bank and anchored on concrete foundations just outside the west wall of the power-house. From this reservoir four forty-eight-inch outlets deliver water to six turbines. The total head is 266 feet. Each outlet is controlled by a gate valve, and all of the valves may be operated at once or singly, either by a Pelton water-wheel or by hand. To assist in relieving any excess pressure, the pipe-line, penstocks and receiver are equipped with relief valves. To allow for the escape or intake of air when the line is being filled or emptied the main line is supplied with inlet pipes.

The machine equipment includes six turbines, four driving the main generators and two driving the exciters. The four larger units are of the Fourneyron outflow type, the wheel-runners discharging the water into a draft tube, Mounted upon vertical shafts, and equipped with hydraulically operated governors of the Porter-Allen type, they are direct-connected to revolving-field, three-phase, 2,300-volt generators. At full gate opening, working under a head of 264 feet, 360 revolutions per minute, they have a rated capacity of 2,000 horse-power. Under test these wheels have developed, in this installation, 2,100 horse-power each.

The Girard type exciter turbines, when



HYDROELECTRIC PLANT OF THE UTICA GAS AND ELECTRIC COMPANY—VIEW OF POWER-HOUSE AND LIGHTNING ARRESTER HOUSE IN GORGE



HYDROELECTRIC PLANT OF THE UTICA GAS AND ELECTRIC COMPANY—SWITCHBOARD.

operating at 750 revolutions per minute, with full gate opening, develop 100 horsepower. These turbines are also on vertical shafts and are direct-connected to 125-volt dynamos. Twelve-inch supply pipes, taken off from the outlet to the large machine nearest and controlled by hand valves, deliver water to the exciter turbines.

The switchboard is of marble, with a panel for each main generator, one panel for the two exciters, and high and low-tension feeder panels. Leaving the low-tension feeder panel, the 2,300-volt current is raised by air-cooled transformers to 23,000 volts. From the high-tension feeder panel the circuits pass out of the power-house through a separate building, where the lightning arresters are located. From this building the transmission line runs to the Utica substation.

The power-house is built of steel and marble, and is 128 feet long and thirty-two feet wide. The interior trim is in white and brown enamel brick to the window sills and above this in cream pressed brick to the roof. The equipment also includes a ten-ton traveling crane, for facilitating inspection and repairs.

That part of the Mohawk valley lying in Oneida and Herkimer counties is the territory mainly served by the company. This includes the cities of Utica and Rome and the villages of Trenton Falls, Oriskany, Whitesboro, Yorkville, New York Mills, New Hartford, Washington Mills, Willovale, Chadwicks, Deerfield, Frankfort, Ilion, Mohawk, Herkimer and Little Falls.

W. A. Brackenridge, of Niagara Falls, N. Y., designed the entire development, and the installation was carried out under his direction. The generators and switchboard were furnished and installed by the General Electric Company, Schenectady, N. Y.; the hydraulic machinery by the I. P. Morris Company, Philadelphia, Pa.; the dam and power-house foundations by the Warren-Burnham Company, Utica; the pipe-line by the T. A. Gillespie Company, New York; the power-house and transmission line by the Utica Gas and Electric Company.

HYDROELECTRIC PLANT OF THE UTICA GAS AND ELECTRIC COMPANY—INTERIOR OF POWER-HOUSE, SHOWING GENERATORS AND END OF SWITCHBOARD.

THE APPLICATION OF THE TELEPHONE TO RAILWAY SERVICE.[1]

BY C. J. H. WOODBURY.

Electricity was considered for railway signaling long before the devices for its application were invented, for in 1828 Edward Davy, of England, made a proposition for the application of electrical signals for indicating the direction of trains, whether stationary or in motion, which appears to be the first available record on the application of electricity to train movements. It does not appear that this form of signaling was proposed to extend beyond giving information to the general superintendent, and did not fully include any suggestion for telegraphing orders which pertained to later applications of the telegraph.

The Wheatstone telegraph was applied for signaling on a cable railway at Blackwall, England, in 1835. On the whole,

[1] Abstract of a paper read before the New England Street Railway Club, Boston, Mass., January 31.

the application of electricity for the communication of intelligence in both directions appears to have originated with the use of the Morse telegraph in 1850 on the Erie Railroad by Charles Minott, general superintendent, although it is claimed that previous to that date railroad men had availed themselves of the telegraph to direct the movement of trains, but his work on the Erie Railroad included the systematic dispatching of trains. This, with steam railroads, has been developed into a most systematic and thoroughly organized department which was an essential portion of the operation of every steam railroad.

Of late years the telephone has taken the place of the telegraph to a very material extent, and its use is rapidly increasing.

The facility which it furnishes for the instantaneous reply, and the conference over matters requiring a presentation of facts at one end and the exercise of executive action at the other without the interposition of skilled telegraph operators, is of great value, especially on occasions of emergencies.

The telephone is admirably suited for application to existing telegraph plants in railway service, for its attachment to such lines does not interfere with the use of the telegraph, nor does the simultaneous use of the telegraph affect the transmission of speech by telephone.

This dual use of the same wires for composite systems is accomplished in a simple manner by the insertion of choke coils at the terminals, and also bridging condensers around the telegraph relays.

These condensers will transmit the alternating currents used by the telephone bell and the undulatory currents of the telephone, but they do not conduct the direct currents used in telegraphy.

That is, the condensers serve in the place of conductors for telephone service, and as insulators for telegraph usage.

These composite sets were first commercially used in New England by the Central Vermont Railroad, and their application rapidly extended to a number of steam railways throughout the country.

The term "labor-saving" invention is generally a misnomer for production-increasing devices, but the telephone is in the former class, as Mr. Frank Thompson, president of the Pennsylvania Railroad, said that the telephone was the only invention introduced during his business career which had been a time-saving device, for while all of the others had added to his work, the telephone had enabled him to transact his duties with so much greater rapidity that it gave him more time to devote to matters of the policy of that great corporation.

The manifold applications of the telephone is indicated by some of the railroads which also have connection with the mining of coal, and their private branch exchanges not only connect with the offices at the headquarters of various divisions of the railroad, the operation of trains, but also extend down into the coal mines and out to the docks where the coal is shipped, and are even connected to telephones in the cabins of the vessels transporting coal, or the tugs which tow the coal barges. On the Mexican Central Railroad all of the cabooses are equipped with telephones so that all freight trains may be at any time in communication with the superintendent's office, in the same manner that the wrecking cars of steam railroads are equipped with telephones which can be attached temporarily to wires of telephone lines near the road by means of rods carrying wires ending in hooks and in that manner coming in communication with the supervising officers.

One of the many instances of the service of the telephone in cases of grave emergency occurred on May 11, 1905, when a passenger train near Harrisburg struck a car loaded with dynamite, whose explosion killed twenty-one and wounded 150, who were taken to the Harrisburg Hospital.

The Pennsylvania Telephone Company set up a private branch exchange in that hospital which was operated by L. H. Kinnard, general manager, while J. A. Crossman, Jr., secretary and auditor of the telephone company, established a card index system on which the names of the wounded and dead were placed as far as known, with the nature of the injuries and the probable outcome of the case as judged by the surgeons in charge. This card index also contained the exact location of the patients in the hospital wards and was continued with additional information from the examining surgeons and ward physicians. Free service was established not merely by the Pennsylvania Telephone Company, but also by the American Telephone and Telegraph Company, with its long-distance plant, so that inquiries from various parts of the country, even to distances of a thousand miles, could be answered at once in a prompt and intelligent manner.

Some of the leading express trains are equipped with telephones which are attached to the central office system at terminals, and also at intermediate points where the stay is longer than for the change of passengers and baggage.

In the early days of electric railroads when the motor was merely a substitute for the horses on the same cars and even at similar speed, there was not the requirement of any signaling system more than the unfilled need which had already existed in the case of horse cars, but with the expansion of the carrying capacity of a road both as to size of cars and speed of propulsion, and above all the long distances of the interurban roads, conditions became radically changed and were comparable to those of the steam roads. This development of the transportation facilities became so much more rapid than that of the signaling that the early electric roads were afflicted with a number of mishaps which gave rise to many serious apprehensions as to the advisability of this change of power.

In electric railways the conditions of speed are comparable to those of steam railway trains and the weight of the cars sufficient to cause destructive results in case of collision, while the requirements of good service at these speeds demanded that there should be constant information of the positions of the various cars en route.

The street railways had the advantage of precedent, and in New England the Worcester Street Railway began to use the telephone in 1899, and since its consolidation with other companies these ramifications extend over a large range of territory throughout the heart of the commonwealth.

The application of the telephone for train dispatching has resulted in a marked economy of both plant and operation in that the ability of the superintendent to be informed as to the position of the various cars and to communicate with their operators gives a greater service efficiency to the road. Single track railways in sparsely settled districts can be operated at an efficiency which should otherwise require a double-track road, merely by the use of the telephone for dispatching, because in case of cars failing to join at meeting points when they are due, they may under this direction avoid delaying the prompt car by directing it to proceed to another turnout. In case of failure to meet at scheduled turnouts there is not the risk of collision by one car running wild to the next switch.

On double-track roads knowledge of occurrences to the rolling stock or of the condition of the road has a similar value,

which increases with the congestion of travel.

The telephone is of great service in severe snow storms by the facility which it affords for information to be given to the train dispatcher as to the condition of the road. It is said that in the old days, before the use of the telephone, snow-plows became snow-bound and lost, because whenever a snow-plow or a car disappeared from the sight of the terminal it was never heard from again until it arrived at the other end or perhaps not until it returned to the starting place.

In cases of mishap the telephone affords means for the quick clearance of the track by the facilities of obtaining wrecking cars or repair hands.

In cases of accident not only can medical help be summoned for the injured, but means can be taken to procure information relative to details of the occurrence which may be of great importance in ascertaining the liabilities of the company.

The efficiency of the telephone in times of emergency was illustrated last June by an incident on an interurban electric railroad west of Frankfort, N. Y., where the cars were limited to the single track during repairs, and to protect the car in the block watchmen were placed at each end. One evening a car went upon this single track at full speed when a car was approaching the other end of the block, and the watchman knew that a collision would be inevitable unless the cars were stopped. There was no time for long stories; he went to his telephone and told the power station to shut off the current, which was promptly done, and a collision averted.

There are three types of application of the telephone to railway dispatching:

(1.) Fixed telephone substations in booths placed at suitable points along the line.

(2.) Jack boxes at poles to which portable telephones carried in the cars may be hung and connected for temporary use.

(3.) Portable telephone sets hung upon the front of the car, whose vestibule platform serves as a booth, and attachment made by flexible wires to jacks at numerous poles along the line.

On some railway lines the method of connecting a telephone on the car with the line is not by means of a jack at the side of one of the poles but by a long slender rod carrying the wires which may be hooked upon the main lines at any place.

The first method does not differ from arrangements of telephone booths with which all are familiar, except in minor details, and does not require explanation.

Portable sets are generally preferred to fixed sets for long mileage and few cars. The experience of the railroads has been preferable for Bell telephones in that the telephone company maintains the plant, so that there is a virtual guarantee of its use, and the railroad company is not obliged to either train men for this work or to send for people who treat the matter as a repair job. This guarantee of the telephone company also insures first-class apparatus, which may not otherwise be forthcoming when it is not the object of active consideration on the part of the manufacturers after its sale.

There are several forms of these portable sets, one with its magneto telephone, coil and dry battery weighing only thirteen and one-half pounds, although more substantial forms are considered preferable.

Jack boxes on the pole must conform to numerous conditions, not merely to be shot-proof or fool-proof against meddlesome people, but also they must not afford shelter for hornets or other insects of perhaps less virulent disposition, but who impede any such apparatus by the nests which they make; they must also be proof against damage by rain or snow.

The telephone wires should be strung below lighting or power wires and well insulated at its points of support.

The lines of such telephones must be transposed at least once in every eight poles, in order to prevent noises on its circuit induced from the wires in its vicinity carrying disturbing currents.

When two telephone circuits are on the same line the transposition must be not only alternating the relative positions of the wires of one circuit to the other, but also of the two circuits.

When the spring jacks in an iron box attached to a pole are connected to a common battery signaling system, the two plugs on one handle are of different size, so that they can not be inserted with wrong poles.

Although still called jack boxes, the plug in the later forms is attached to the under side of an iron canopy, resembling a large petticoat insulator, and the spring jacks are in the handle at the end of the flexible wires leading from the telephone set.

On account of the exposure of these telephone lines to foreign currents extraordinary care should be taken for their defense at every jack or other point of connection, by the use of protectors and repeating coils.

The telephones used on electric railroad systems must give transmission which is clear and loud, and be of types not liable to be placed out of service by the jar of continuous transportation on a car.

Fixed telephone sets are found preferable on electric railways having a large number of cars and congested traffic, as they may be used more rapidly by merely attaching the flexible wires to a pole than when it is necessary to take a telephone set from the car and hang it upon a pole.

Especially in stormy weather it is a distinct advantage for the motorman to use the telephone in a vestibuled platform which serves as a booth.

The National Electric Light Association and the National Electrical Code.

Arthur Williams, president of the National Electric Light Association, has issued a note to the membership suggesting the advisability of calling to the attention of the chairman of the association's code committee any changes in, or additions to, the existing rules, which should be considered at the meeting of the electrical committee of the Underwriters' National Electric Association, to be held early in March.

The members of the National Electric Light Association's committee on the code are as follows:

Ernest H. Davis, chairman, West and Willow streets, Williamsport, Pa.; Samuel Scovil, The Cuyahoga, Cleveland, Ohio; Louis A. Ferguson, 139 Adams street, Chicago, Ill.; William Brophy, 17 Egleston street, Jamaica Plain District, Boston, Mass.; Alexander Henderson, 39 Cortlandt street, New York city; E. A. Norman, 55 Duane street, New York, is acting as secretary to the committee.

Committee on Municipal Ownership of the American Street and Interurban Railway Association.

The following announcement has been made of the personnel of the committee on municipal ownership of the American Street and Interurban Railway Association:

C. D. Wyman, chairman, general manager Stone & Webster, Boston, Mass.; John A. Beeler, general manager Denver City Tramway Company, Denver, Col.; George F. Chapman, general manager United Railroads of San Francisco, San Francisco, Cal.; H. M. Sloan, general manager Calumet Electric Street Railway Company, Chicago, Ill.; J. J. Stanley, general manager Cleveland Electric Railway Company, Cleveland, Ohio.

MAGNETIC LEAKAGE AND ITS EFFECT IN ELECTRICAL DESIGN—II.[1]

BY WILLIAM CRAMP.

(Concluded.)

Alternators—In approaching the question of leakage in alternators, I wish it to be understood from the outset that I intend to confine myself almost entirely to useful leakage, or, rather, to showing how use may be made of that leakage which must exist. Already to some extent this has been done, as, for instance, in the case of the constant-current alternator, which is so constructed that beyond certain points every tendency of the current to increase is checked by that increase itself producing (through leakage flux) a voltage in the armature turns.

A distinction may be drawn between field leakage and armature leakage, but in practice these two are very hard to separate. As load comes on a single-phase alternator, armature reactance causes a fall in pressure at the alternator terminals, but it also causes the cyclic variation of armature current to lag in time, so that the relative position of armature and field corresponding to maximum current is changed, with the result that weakening of the field takes place, which causes a further drop in the armature potential difference. Thus the action of a constant-current alternator may be just as much due to distortion and destruction of the main field as to armature reactance; but since the path of a continuous magnetic field is a more easy matter to deal with in calculation than armature reactance, I think a better constant-current machine may be designed by providing a definite by-pass, so to speak, for the field flux, than by attempting to provide leakage paths for the armature flux. Therefore, armature reactance should in every case be kept as small as possible, while reactance of the armature upon the field should be allowed to cause the latter to leak, and thus produce the constant-current effect. The same idea may be adopted to cause the alternator to be self-compounding—*i. e.*, it may be used either to cause an excessive fall in volts, or to keep them constant, or to cause them to rise.

The method which I employ is specially applicable to alternators of the inductor type, and may be explained as follows: Fig. 5 is a section through a special inductor alternator. R is the stator or stationary armature, forming also part of the magnetic circuit. S is the rotor, and would carry normally the rotating inductors to produce the necessary variations of flux. A_1, A_2, A_3 are air-gaps, and it is evident that if F is the only coil producing the magnetic field, then A_1 and A_2 are magnetically in series, as also are A_1, A_3, whilst A_2 and A_3 are magnetically in parallel with respect to A_1. Suppose now that the armature coils are wound upon the stator at A_2, while the other two air-gaps remain as simple smooth-bore flux paths. If F be excited by a constant current, the coils A_2 will generate a certain open circuit electromotive force when R rotates at a certain speed, depending upon the relative areas of A_2 and A_3. Directly any current is taken from the coils at A_2 armature reaction is set up, which immediately increases the reluctance of the path of the field flux through A_2. In consequence, more of this flux tends to leak by A_3, producing thereby a very large fall of voltage, which will tend to keep the current at A_2 constant.

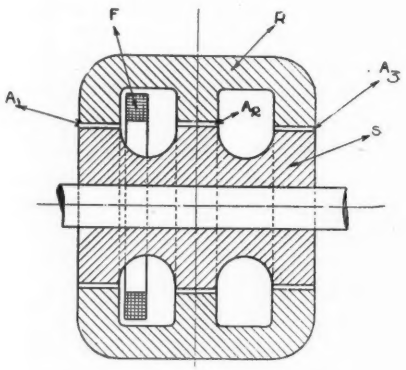


FIG. 5.—SECTION THROUGH SPECIAL INDUCTOR ALTERNATOR.

This is particularly the case if the air-gap at A_2 be small, and the density high with respect to A_3, so that by carefully adjusting the areas of the gaps and the densities, an alternator may be so constructed that a very small change of current through the coils at A_2 only takes place, even if the resistance in circuit with these coils is changed from a large value to short-circuit. Similarly if the armature coils be placed at A_3, a still more pronounced effect is obtained. Complete regulation and control of this effect is obtained if a second field coil be placed in the recess between A_2 and A_3 and connected in parallel with F. A resistance and reversing switch in series with this second coil will enable all the changes to be produced from an alternator having practically a constant-current characteristic to an alternator having the characteristic of a machine intended for ordinary constant-potential supply. If the two field coils are so adjusted so that both tend to make A_1, A_3 the path of their flux, the effect of the second field coil is equivalent to a great reduction of the reluctance at A_3, while when the two are in opposition they both send their flux through A_2, and tend to prevent any possibility of leakage. Thus in either case the armature at A_2 may be wound as if for constant potential. It will be seen that, since the reluctance of each circuit is nearly inversely proportional to the areas of the respective gaps, the calculation for any particular characteristic is extremely simple compared with that required for the ordinary constant-current alternator; and, further, ample adjustment for errors in calculation may easily be provided by means of the second field coil above referred to.

In applying these principles to obtain a machine which shall with varying currents give constant-potential difference, we shall have to provide at A_3 a steadily increasing magnetomotive force of such sense that it would oppose the leakage from F. This is equivalent to compounding in the ordinary way, and by consequence involves a continuous current increasing with the load. In order to compass this, and also to make use of the air-gap A_3, I have placed on the rotor at A_3 a continuous-current armature and commutator, and have broken up A_3 into salient poles. The brushes on the commutator being connected through suitable rheostats to the field coil, F, we at once have a machine which is self-exciting. Not only this, but the increase of alternating current at A_2 by tending to increase the reluctance of that path, tends also to shunt more flux through A_3, whereby the voltage at the commutator is increased and with it the exciting current, so that the voltage at A_2 returns to its original value. In this way the machine becomes both self-exciting and self-regulating; self-regulating not only as regards voltage drop due to increase of current on the alternating side, but also as regards change of power-factor involving no change of current. For if the power-factor of the alternating-current circuit be reduced, the armature reaction at A_2 is increased, which normally causes a fall of potential difference, but in this case automatically compounds itself by increasing the exciting current. Moreover, the machine may actually be made so that it over-compounds, the question of the amount of compounding depending simply upon the saturation of the iron paths at A_2 relatively to those of A_3.

[1] Abstracted from a paper read before the Manchester section of the Institution of Electrical Engineers of Great Britain on January 8.

Fig. 6 shows a section through an actual machine constructed upon these principles.

It should be pointed out that when constant current is required, instead of reducing the reluctance at A_3 (Fig. 5), we may, if we please, increase the reluctance at A_1. This is very easily carried out if the exciter armature be placed at A_1, for then any increase of current at A_2 increases the reluctance of the whole magnetic circuit sufficiently to drop perceptibly the exciting electromotive force. In this case, then, the air-gap, A_3, is not required, but it may be of use in order to give (by allowing a second field coil between A_2 and A_3) a better magnetic distribution at A_2.

In criticizing the use to which these machines may be put, I should be inclined to say that, as constant-current machines are self-exciting, the size of the exciter armature would limit their adoption to comparatively small units, but where separate excitation is adopted there is no limit to the output for which they are suitable.

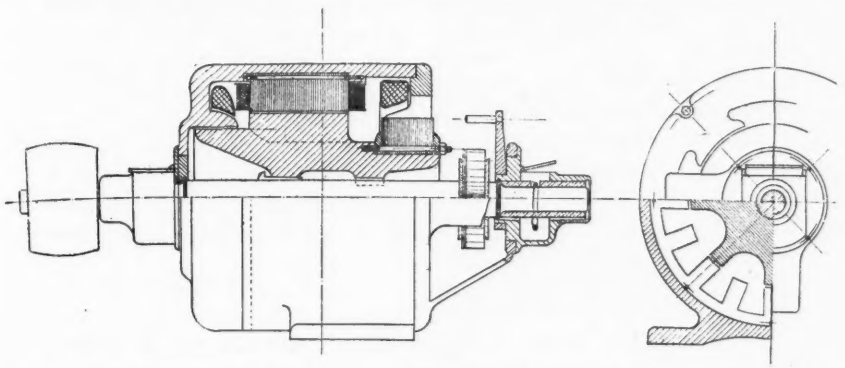


FIG. 6.—SECTION THROUGH MACHINE CONSTRUCTED UPON PRINCIPLES OUTLINED IN ARTICLE.

In considering in the same way the constant-potential type, I should be inclined to think that in such sizes as will entail less than a two per cent loss for excitation, the exciter armature and its magnetic circuit would be too small to properly allow of the regulation being obtained. This, however, needs more practical demonstration. I should like to point out that the self-exciting constant-potential characteristic, which corresponds very nearly to that of a shunt direct-current machine, is obtained by having two armatures magnetically in parallel; while the constant-current characteristic, which corresponds to the series direct-current machine on heavy loads, is obtained by means of two armatures magnetically in series.

One use further may be suggested for machines of this type—*i. e.*, as a new form of motor converter. If the alternator armature be supplied with an alternating current while the rotor is run up to speed, the machine will run as a synchronous motor, because the direct-current armature will excite and set up a field current. When in synchronism, increase of load will tend to strengthen the field magnetism by reducing the reluctance upon the synchronous motor side, so that the machine will automatically compound for fall of voltage upon the direct-current side. Thus we have a motor converter with its direct-current voltage completely under control and tending automatically to compound, while economy and efficiency are obtained by the use of one field coil for the two armatures.

Alternating-Current Motors—In alternating-current motors the great importance of the dispersion or leakage factor in determining the characteristics of the various motors as exemplified in the semicircle diagram has led to a great deal of practical research upon the subject, most of which was brought together at the meeting of this Institution in London when Dr. Behn-Eschenberg read his paper upon the subject. Since that date, however, the great advance which has been made in the direction of alternate-current commutator motors necessitates the division of the subject here into (1) motors without salient poles and (2) motors with salient poles. To the former class belong all induction motors, and, indeed, all those motors which depend upon a rotating field for their performance, among which must be reckoned the ordinary repulsion motor with its various modifications. The results in the paper referred to give, for the most part, an excellent approximation for the designer's guide in estimating the leakage factor, and it is only necessary for me here to draw attention to one or two points which appear to some extent to have been overlooked.

The first of these is the fact that no distinction is drawn in the paper between ordinary and hemitropic windings. Now, since the theoretical short-circuit current is the terminal voltage divided by the calculated reactance of the windings, while the theoretical no-load current is the calculated magnetizing current, it follows that the latter is the same whether ordinary or hemitropic windings are used, while the former is in the hemitropic winding smaller than that of the ordinary winding. This is easily proved as follows: If f be the number of C.G.S. leakage lines produced by unit (C.G.S.) current in one turn of a coil, and t be the number of turns in the coil, then the coefficient of self-induction for that coil is

$$\text{L (henries)} = \frac{t^2 f}{10^9}.$$

Thus the reactance per coil

$$= 2\pi \times \sim \times \frac{t^2 f}{10^9} \text{ ohms.}$$

In a hemitropic winding we have C coils in series per phase and t turns per coil, so that reactance per phase hemitropic

$$= 2\pi \times \sim \times \frac{t^2 f}{10^9} \times \text{C} \ldots\ldots (1)$$

In an ordinary winding we have 2 C coils in series per phase and $\frac{t}{2}$ turns per coil.

Reactance per phase (ordinary)

$$= 2\pi \times \sim \times \frac{t^2 f}{4\ 10^9} \times 2\ \text{C} \ldots (2)$$

and obviously (1) is twice (2).

In practice the hemitropic winding is not found to have a reactance equal to twice that of an ordinary winding, probably because the above calculation assumes that in each case the leakage lines of each coil only link with the turns of that coil, which is most unlikely; and also because the fraction of stator face devoted to the wires of one side of a coil is usually greater in the hemitropic form. But there is in practice a difference, though it is not so great as two is to one; and this is almost certain to be the case, because the inductance of the end connections of a hemitropic winding is twice as great as the inductance of the end connections of an ordinary winding, and also because fewer slots are used in the hemitropic case. In my opinion the difference between hemitropic and ordinary reactance per phase is in the proportion of about five to four. Another point to which I wish to draw attention is the discrepancy in Dr. Behn-

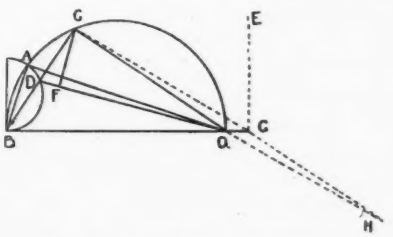


FIG. 7.—MOTOR CHARACTERISTICS.

Eschenberg's formula pointed out by Professor S. P. Thompson—*i. e.*, the fact that in the second term the factor which takes into consideration the bridge of the slot has been omitted, so that instead of

$$v = \frac{3}{N^2} + \frac{\Delta}{X\,N\,T} + \frac{6\ \Delta}{b}$$

we have

$$v = \frac{3}{N^2} + \frac{10\ \Delta\ e}{X\,N\,T} + \frac{6\ \Delta}{b}$$

where

N = mean value of slots per pole in rotor and stator.

Δ = air-gap length in millimetres.

b = gross axial core length in millimetres.

e = { mean edge thickness of tooth for open slots = mean of edge thickness of stator teeth and of thickness of thinnest part of iron bridge over rotor slots when closed } in millimetres.

X = { average slot opening for open slots in rotor and stator = average of slot opening in stator and length of thinnest portion of iron bridge over closed rotor slots } in millimetres.

T = pole pitch measured upon stator face reduced by $(X \times N)$ in millimetres.

This change renders the formula a simple numeric—*i. e.*, without dimensions and results in a better approximation for the value of v. Another point omitted by Dr. Behn-Eschenberg is the effect of "squirrel-cage" against "wound" rotors. Naturally, for the former v will be less than for the latter, and this change is, I think, about in proportion of 0.8 to 1. In Table IV are some calculations which show the sort of approximation obtained with this expression.

TABLE IV.—VALUES OF v IN INDUCTION MOTORS.

Motor No.	1.	2.	3.	4.
Maker	Electrical Co.	Oerlikon	Brown-Boveri	Siemens Bros.
Phases	3	3	2	3
Output	5 h.-p.	5	2	5
Poles	4	4	6	6
Speed (sync.)	1,500	1,500	2,000	1,000
Type winding	Star hemitropic	Star hemitropic	Ordinary	Star or △ ordinary
~	50	50	100	50
v calculated	.0563	.048	.087	.071
v from test	.054	.048	.077	.067
Rotor	Wound	Wound but short-circuited	Squirrel-cage	Wound

No allowance has been made for hemitropic windings or squirrel-cage rotors in the above, and my belief is that for hemitropic windings and wound rotors the formula is right. For ordinary windings it must be multiplied by 0.9, and for squirrel-cage rotors by 0.9.

These results on four motors chosen at random show that there is little fault to find with the calculation of v by Dr. Behn-Eschenberg's formula, and when the value of the leakage factor in such machines as those given above is compared with that of similar-sized continuous-current motors, one is struck with the effect which a small air-gap and a coil close to the armature have upon the machine. The five-horse-power motor in column 1 has a leakage factor 1.054, while the five-horse-power direct-current motor we were considering at the beginning of this paper has a leakage factor as large as 1.35. Well may induction motors be smaller than continuous-current machines!

Having thus shown that little improvement is to be looked for in the calculation of the leakage factor of rotating-field motors, I pass on to the machines with salient poles. That the principles laid down as affecting continuous field design are much better recognized in the world of alternating currents is sufficiently apparent. Nearly all salient-pole alternate-current motors are fitted with field coils spreading almost over the pole-pitch, and the pole is kept short, while neutralizing windings are used to reduce the armature leakage. These devices (on account of the mischievous effect of magnetic leakage in alternating-current work) have had to be adopted by alternating-current designers, and those engaged in the design of continuous-current machines would do well to profit by them. Harmful leakage in salient-pole alternating-current motors is reduced to a minimum. Useful leakage, on the other hand, has never been made much of. In the starting up of single-phase motors it has been utilized, as also it is the principle really involved in the repulsion motor. I wish to show that it can be quite as well employed in that modification of the series motor which I first suggested at a meeting of this Institution about twelve months ago. I give here the theoretical figures and advantages, which is most easily done by commencing with the semi-circle diagram for a series motor.

When the armature is locked, a plain series motor behaves exactly as a choking coil—*i.e.*, if in Fig. 7, O A represents the locked current for full terminal potential difference, then it also represents to a voltage scale the reactance drop in the motor, and A B at right angles to O A represents the resistance drop. O B is, therefore, the voltage to drive the current, O A, against the motor impedance—that is, the full motor potential difference—while O B A is the angle of lag of the machine current behind the applied potential difference. Releasing the armature and allowing it to run (still keeping the terminal potential difference constant) we have an electromotive force set up in the armature windings practically in phase with the main field flux, but, like the resistance drop, opposing the armature current. This has the effect of reducing the current, O A, through the addition of an electromotive force in phase with the armature resistance drop, B A. Thus B A is increased to B C, and B C O still remaining a right angle, the current line, O A, has for its locus a semi-circle upon O B as base.

Reduction of O A to O C, of course, proportionally reduces the resistance drop, so that A moves on the semi-circle A D B, while C traverses the semi-circle B C O. Thus for any position C, to the current scale (fixed by O A as short-circuit current A B O as angle of lag given by the wattmeter),

O C = current taken.

To the voltage scale (fixed by O B = full terminal volts)

O C = motor reactance drop.

B D = motor resistance drop.

C O = back electromotive force.

Also, since output = back electromotive force × current, it is = C D × C O, or proportional to the height of the perpendicular from C upon O D—*i. e.*, to C F. The torque is proportional to O C^2.

Now, the diagram has to be modified in practice to take account of saturation and iron losses, but it is near enough to prove substantially that if (1) the resistance voltage be low (B D) and (2) the back electromotive force be high (D C) compared with the reactance drop (C O), then the motor will be good both as to power-factor and efficiency. (1) and (2) above are easily attained in practice by well-known means. Now, if having designed an ordinary series bipolar motor, such as that shown in Fig. 8, I apply to its

top another limb *a*, properly wound, and attached to the mains, and if then I join the free end of the present field to the free brush, I shall have a motor whose main and leakage magnetic paths are in parallel exactly as they are in an ordinary induction motor, with these differences: (1) that in an ordinary induction motor the torque is produced by the main field and the rotor current, while here it is by leakage field and rotor current; and (2) that in an ordinary induction motor all the brake horse-power has to cross an air-gap,

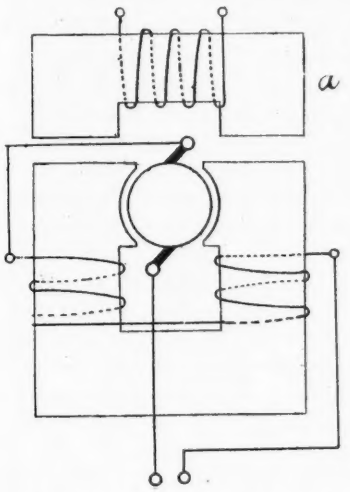


FIG. 8.—SERIES BI-POLAR MOTOR.

while here only part need cross it. These two points are well brought out in the change in the semi-circle diagram. The new primary coil will have a very small resistance, and, consequently, at constant terminal volts the flux through it will be practically constant, and the magnetizing current practically constant also. If the joints in the circuit be good, there is no reason why the magnetizing current should be large, and we may draw it as O G (Fig. 7); so that the total primary current is now O H (= G C). The flux across the air-gap will now be slightly increased, but also slightly shifted in phase away from O C towards G C, and so the torque still remains practically proportional to O C^2. The power-factor is changed from cos C B O to cos C G E, and the primary current from C O to C G. Otherwise the motor remains precisely as before, excepting for the fact that we may wind the high-tension side for any voltage we please, and we may regulate entirely on the low tension, which windings might be stocked for each size. Also this very change admits of possibilities of improving the slightly reduced power-factor and of immensely improving the commutation by altering the number of armature and leakage limb turns respectively. The armature self-induction is always a problem in high-tension motors, and it is this problem which affects both power-factor and commutation.

Now the self-induction of the armature depends upon the square of the armature turns per pole. Thus a small decrease of the turns produces a large change in the coefficient of self-induction, and hence also a large change in power-factor and much easier commutation. Or, to put this matter in another light, these motors may be built with fewer poles than ordinary series motors for the same power-factor. Of course, there is no difficulty about multipolar designs for this type of machine.

The nearest parallel to the above motor in use at the present day is the repulsion motor, represented diagrammatically in Fig. 9. In this motor the short-circuited armature is fed through induction by coils A, while coils B provide the field flux. A and B are placed in series across the mains. When the locked test is applied to such a motor, it is seen that the coil A is relatively non-inductive compared with the coil B, hence a phase displacement of flux takes place, setting up a rotating field somewhat similar to the starting system of an ordinary single-phase induction motor; and, in order to take full advantage of this, a stator without salient poles, like that of an ordinary induction motor, must be provided.

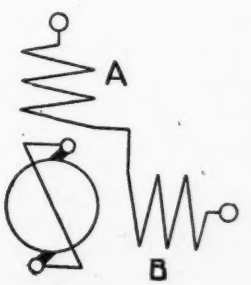


FIG. 9.—REPULSION MOTOR.

A comparison of the motor shown in Fig. 4 with the same motor without the additional limb A reveals the fact that for electrical circuits in series magnetic circuits in parallel are used, an additional confirmation of the principle just laid down. Also, we note that in Fig. 9 not only has a flux at B to cross the air-gap, but also a flux at A, so that the whole energy imparted to the rotor has to cross the air-gap. This is the secret of the low power-factor obtained with repulsion motors. For the sake of clearness, we may compare four motors with similar characteristics, as shown in Table V.

TABLE V.

	Series Motor Simple.	Series Motor with Transformers.	Repulsion Motor.	Cramp Motor
Suitable to voltage	Low only	Any	Any	Any
Power-factor	Good	Good	Fair	Good
Commutation	Depending on voltage	Good	Only good at sync.	Very good
Iron weight	1	1.75	1.1	1.25
Copper weight	1	1.75	1.3	1.25
Easy to wind	Very	Moderately	No	Very
Compensation coils required	Yes	No	No	No

It is thus seen that for low voltages the simple series motor is best, while for high voltages my motor is best, a verdict which I hope shortly to be able to endorse by definite tests.

The Theory of Flicker Photometers.

There are several forms of flicker photometer, some depending upon direct illumination of surfaces, and others utilizing the grease-spot principle of the Bunsen photometer. The advantage of flicker photometers, says J. S. Dow, lies in the fact that an unpracticed observer is usually able at once to distinguish the point of disappearance of a flicker, while it requires a certain amount of practice to judge quality of illumination or contrast; but there does not seem to be any gain in sensitiveness to a practiced observer unless the contrast method be introduced. This may be accomplished by making the field of view of appreciable size, so that those portions of it nearest to the lamps are lighted more intensely than the centre portions. This will cause a flicker to take place at the edges of the field of view when the centre portion appears flickerless. With this arrangement the photometer is sensitive to a slight change of position, not because a flicker appears in the centre of the field, but because the flickers at the edges become unequal. This gives a double effect similar to that used in the contrast form of Lummer-Brodhun photometer, and there is a distinct gain in sensitiveness thereby. A drawback to

the use of flicker photometers is their fatiguing effect on the eye. The exact explanation of the sensation of flicker is not known with certainty, but it is said to be caused by the efforts of the nerves of the eye controlling the iris diaphragm to keep pace with the change in illumination. However this may be, there is certainly some violent nervous action going on in the eye which makes it impossible to use a flicker photometer with accuracy and effort for a long time at a stretch. The author has used ordinary photometers for days at a time without suffering, but when he attempted to use a flicker photometer the after-effects became troublesome. For days afterward his eyes were affected by occasional spasms of the throbbing flicker sensation, and a distinct flicker would occasionally be seen if the eyes were turned toward a dark background. He has found that this fatigue may affect materially one's judgment of balance, and thus detract from the sensitiveness of the apparatus. It has been suggested that color-blind persons obtain the same results with flicker photometers as persons of normal sight. People for whom the red sensation does not exist can not detect red light and red objects appear black. If, therefore, such a person could, when comparing red and green, obtain the same results as a normal-sighted observer, it would merely show that the flicker photometer depended upon some law which was not applicable to the measurement of illumination. Certain experiments which he has conducted confirm this view, as it was found that for lights of different colors the reading of a flicker photometer depends appreciably on the angle subtended at the eye by the field of view. The field of view is limited by certain practical restrictions, and it does not seem likely that grave differences would be introduced in this way under the ordinary conditions of photometry; but when the two lights compared give out light of practically pure colors, the size of the orifice through which the illuminated surfaces in the photometer are observed seems to make a distinct difference in the results. It seems that photometers depending on the method of flicker and the method of quality of illumination or contrast are all influenced by the natural consequences of the laws of color vision; but this, so far from being a drawback, must be regarded as a vindication of the flicker photometer. For scientific purposes the only satisfactory method of comparing lights appears to be the conventional method of adopting a standard spectrum and comparing each portion of the spectrum of the light source with the corresponding portion of the spectrum of the standard.—*Abstracted from the Electrician (London), February* 1.

ELECTRIC HEATING AND ITS APPLICATION TO THE FUSION AND FIRING OF REFRACTORY MATERIALS.[1]

BY R. S. HUTTON, D.SC.

Quite a large number of industrial processes depend upon the production of high temperature by fuel heating. In many of these cases, in the course of general advance in practice, the limit of temperature aimed at has tended to rise considerably; but it has unfortunately seldom been possible to prevent a corresponding decrease in the efficiency of the utilization of the coal.

Those who make it a practice to keep constantly in mind the possibility of the introduction of improvements in such industries as these, can not fail to have noted the remarkable progress which is being made in the application of electricity for the production of high temperatures.

The progress along these lines has followed very closely the advance in the economical generation of electric energy, which has been so marked during the past few years.

Serving, at first, solely for the initiation of new industrial processes, demanding temperatures quite beyond the scope of fuel heating, electric heating is already being widely applied in cases where the temperatures required are just within the limit attainable with gas or coal firing, and the general tendency is undoubtedly towards its use for still lower ranges of temperature.

There is no panacea in the word "electricity"—except, indeed, to the charlatan—and improvements in economy and convenience are the sole explanation required for these facts.

It should, however, be clearly pointed out that the success of the application of electric heating often depends more upon the appalling inefficiency, due to the wasteful employment of coal, in the process being displayed, than upon any intrinsic advantages of electric heating.

The chief advantages of the application of electricity in this connection may be said to lie, (1) in that it enables the heat to be generated just where it is required—inside rather than outside the chamber containing the material to be heated; (2) in the simplicity of a delicate regulation of temperature; (3) in the ease with which the furnace or kiln can be provided with a really efficient heat-insulation, capable of minimizing the thermal losses to the outside air.

[1] Reprinted from the Transactions of the English Ceramic Society, 1905-6, vol. v, part 2.

Without any hope or desire to herald revolutionary changes in the ceramic industry, I willingly acceded to Dr. Mellor's suggestion to give the English Ceramic Society an account of some of the directions in which this subject is advancing.

PART I.—LABORATORY AND EXPERIMENTAL APPLICATIONS.

Just as the metallurgical industry has been able to make far-reaching applications of the investigations on the heat treatment of metals, so, undoubtedly, could the ceramic and allied industries benefit by a thorough and methodical experimental study of the changes in the physical properties of the various oxides and other bodies which enter into the composition of their raw materials, caused by a variation in the temperature at which they have previously been fired.

Something has already been done in this direction; the work of Ditte[1] on magnesia, and of Le Chatelier[2] on silica occurs to one; but this only serves to emphasize how little has really been accomplished.

Recent work on alumina[3], magnesia[4], and magnetic oxide of iron[5], show how very greatly their properties are altered by exposure to high temperatures in the electric furnace, and, in the first case mentioned, application has already been made to the ceramic industry, apparently with the promising result of producing a stoneware material capable of withstanding comparatively rapid heating.

Then, again, it is frequently of importance to know the temperature at which a ceramic material fuses, or perhaps rather to know the point at which it begins to soften and lose its shape.

In all such cases, for laboratory purposes, the use of small furnaces or kilns, in which electric heating is adopted, offers many advantages. Without entering into detail, the following types may be briefly referred to:

(1.) Wire Wound Furnaces—In these the heating is accomplished by an electric current traversing a nickel or platinum wire wound round the tube or chamber to be heated.[6]

For instance, a porcelain tube, which is to serve as the heating chamber, may have a spiral coil of thin nickel wire (suitable

[1] A. Ditte, *Compt. Rend.*, 73, 111, 191, 270, 1871.

[2] H. Le Chatelier, *Compt. Rend.*, 111, 123-126.

[3] M. Buchner, *Zeit. Anz. Chem.* 17, 985-988, 1904; *Chem. Trade Jour.*, 35, 398, 1904.

[4] H. M. Goodwin and R. D. Malley. Paper read before Amer. Electrochemical Soc. at Ithaca, N. Y., May, 1906.

[5] H. Specketer, (Griesheim Elektron Co.) U. S. A. Patent 800,181, 1905.

[6] G. Charpy, *Bull. Soc. d'Encouragement*, (4), 10, 660-675, 1895; A. Kalähne, *Ann. der Physik*, (4), 11,257, 1903; J. A. Harker, *Phil. Trans.*, [A], 203,361, 1904; W. C. Heraeus, *Zeit. Elektrochem.*, 8, 201-203, 822-824, 1902.

for temperatures ranging up to 1,100 degrees or 1,200 degrees) coiled tightly on its outside, the tube being then jacketed with a thick layer of some heat-insulating material, preferably stratified.[1]

Furnaces of this type in conjunction with a thermoelectric pyrometer admit of very delicate temperature adjustment; moreover, the nature of the gas atmosphere in which the heating is carried out can be varied at will.

Now that these furnaces are being made in this country, and the necessity for ordering from Germany no longer exists, they should find extensive applications.

(2.) Carbon Resistance Furnaces—Although, by substituting platinum for nickel wire in the type of furnace previously mentioned, temperatures up to about 1,350 degrees can be safely attained, the cost of platinum is for many purposes prohibitive. For the same reason, the iridium tube furnace[2] of Nernst can scarcely be recommended except in very special cases, although temperatures of some 2,100 degrees can be reached.

Very satisfactory laboratory kilns can be constructed from carbon tubes which become heated by the resistance which they offer to the passage of an electric current.[3] Here, again, the inside of the tube forms the heating chamber, the outside being jacketed with some material, which, in this case, must not only be a good heat insulator, but must also protect the carbon tube from oxidation. Both "carborundum fire sand" and soot have been used for this purpose[4] with some success, and temperatures of over 2,250 degrees have been attained. At these temperatures some form of optical pyrometer[5], such as that of Wanner or Féry, enables the progress of the heating to be followed with considerable exactitude.

The only disadvantage of this type of furnace lies in the low electrical resistance of the carbon tubes. Currents of several hundred amperes are required even for the smaller tubes, and with a tube of two and one-half inches internal diameter and two feet length, a current of some 1,000 amperes at 10 volts is required to attain 1,900 degrees to 2,000 degrees. When alternating current is available, the installation of these tube furnaces should be possible even in ordinary laboratories.

A rather different type of carbon resistance furnace is that in which granular carbon, surrounding the chamber or material to be heated, serves to conduct the current. The granular carbon should be ground, sieved, and graded; the heating being much more uniform if the grains are approximately of the same size. Furnaces of this type have been widely adopted; at the Berlin Porcelain Works they have been used up to about 1,700 degrees.[1] For really high temperature work, however, their application is limited by the impossibility of finding a suitable refractory material of which to construct the walls of the heated chamber.

(3.) Electric Arc Furnaces—Where the very highest temperatures are required, the use of the electric arc offers many advantages. It is much easier, as a rule, to concentrate the expenditure of a large amount of power in an arc than in an ordinary resistance, and consequently the rate of heating and the limit of temperature attained is in this case frequently superior.

The arc may be open, and the heat radiated from it be thrown downwards upon the material under investigation, as in the well-known furnace used by Professor Henri Moissan,[2] or the arc may be directly surrounded by the substance to be heated, and thus smothered. In the latter case the heat can obviously be more economically employed.

Several forms of arc furnace suitable for laboratory work have been described elsewhere.[3] The application, by Hempel, of the arc furnace to the determination of melting points is of special interest in connection with this subject.[4]

PART II.—INDUSTRIAL PROCESSES.

It must be confessed that few of the refractory materials which are at present produced on a technical scale by electric heating are at present of direct interest to the ceramic industry. In quite a number of cases, however, the methods of working are capable of application in other directions, and the products themselves are well worthy of consideration.

In the following brief notes the chief materials to be described are carborundum, graphite, alumina, magnesia and silica; and, since many detailed accounts of some of these industries have already appeared,[1] it is intended chiefly to deal with the recent progress which has been made.

Carborundum—The manufacture of carborundum, which is carried out at Niagara Falls, has increased steadily until now it may be considered quite an important industry.

The process consists essentially in heating a mixture of sand and coke to a high temperature. The mixture completely surrounds a central heating core of coke through which a powerful electric current is passed, the charge being kept in place by temporary walls of fire-brick. Some 5,000 horse-power is at present employed in this industry; the individual furnaces, for the most part, consume 1,000 horse-power, and each furnace is continuously run for about thirty-six hours; after which the current is switched off, and a fresh furnace started. Recently a batch of 2,000 horse-power furnaces have been installed. The output of a 1,000-horse-power furnace in thirty-six hours is about 3.15 tons (metric) of crystalline carborundum; whereas the total production of this substance in 1904 was about 3,152 tons. Although most of the crystalline carborundum is used as an abrasive, considerable quantities of "amorphous carborundum" and "siloxicon," which are both products formed at a lower temperature in a similar type of furnace, are coming largely into use as refractory materials.

At the present time a large factory is being equipped at Niagara for the manufacture of bricks, crucibles, etc., made of "siloxicon." Much attention has been given of late to the problem of agglomerating the powdered carborundum with a view to making strong vessels of this material.[2] Among other similar uses, the lining of kilns with bricks coated with a thin layer of carborundum may be mentioned.

Artificial Graphite—This industry, like that of carborundum, owes its development on a large scale to the inventive genius of E. G. Acheson. The process consists in the electrothermic transformation of amorphous carbon into graphite. The carbon in the form of bars and rods, produced by a similar method to that employed for making carbon electrodes for arc lamps, is heated to a high temperature in a resistance furnace, very similar in

1 R. S. Hutton and J. R. Beard, *Trans. Faraday Soc.*, 1, 264-270, 1905.
2 W. Nernst, *Trans. Amer. Elektrochem. Soc.*, 3, 75, 1903; *Zeit. Elektrochem.*, 9, 623, 1903.
These furnaces have recently been successfully used for melting point determinations of ceramic products. See W. C. Heraeus, *Zeit. Anz. Chemic.*, 18, 49-53, 1905; 19, 65-66, 1906.
3 R. S. Hutton and W. H. Patterson, *Trans. Faraday Soc.*, 1, 187-196, 1905.
4 Titanium carbide is recommended by the General Electric Co. See J. E. Ober, U. S. A. Pat. 812,801, 1906, *Brit. Pat.* 20,810, 1904.
5 C. W. Waldner and G. K. Burgess, "Optical Pyrometry," Bull. Bureau of Standards; Washington, No. 2, 1905; also, *Jour. I. and S. Inst.*, 65, I, 98-187, 1904.

1 M. Simonis and R. Rieke, *Sprechsal*, 39, 589-591, 633-635, 1906. Mention should also be made of the "Kryptol" furnaces which are of this type.
2 H. Moissan, "The Electric Furnace," London, 1904.
3 R. S. Hutton and J. E. Petavel, *Journ. Inst. Electr. Eng.*, 32, 222-247, 1902.
4 W. Hempel, *Berichte Inter. Kongress Angew. Chem., Berlin*, 1, 715-725, 1903; Bone Ash, 1,500 degrees; Lime, 1,900 degrees; Quartz (softening), 1,700 degrees; Magnesia, 2,250 degrees; Alumina, 1,880 degrees.

1 See *e. g.* R. S. Hutton and J. E. Petavel, *Jour. Inst. Elect. Engineers*, 32, 222-247, 1903. (Reprinted in several technical journals where full references can be found.)
2 See F. A. J. FitzGerald, "Carborundum" Monographie XIII.—Ueber angewandte Elektrochemie, Halle, 1904; Carborundum Co., Engl. Pat. 9,963, 1904; E. G. Acheson, U. S. A. Patent 722,703, 1903; L. E. Müller, Fr. Patent 329,232, 1903; Gebr. Siemens, Engl. Patent 21,347, 1905.

type to that employed in the manufacture of carborundum, and during this heating is completely transformed into graphite. The product has been employed chiefly in the electrical industry, but recently the process has been extended, and the graphitization of lumps of anthracite coal and coke is now carried out. The resulting material is displacing natural graphite in many of its varied uses. In 1904 some 1,450 tons (metric) of artificial graphite were produced, 1,000 horse-power being continuously employed. The plant has now been duplicated owing to the increasing demand.

Fused Alumina—From quite early times investigations of the effect of high temperatures upon alumina have been carried out. The object of this work, in the first place, was the production of artificial rubies. After much painstaking work, in which other French scientists have taken part, Verneuil[1] has succeeded in producing fairly large masses, and has recently described his most ingenious method of working.

The first extensive application of fused alumina must, however, be ascribed to the Norton Emery Wheel Company, who have for long been well known as manufacturers of abrasive articles of natural corundum, and who acquired an electric furnace process of fusing bauxite, and installed a plant at Niagara Falls. Their product is put on the market under the name of "alundum," to distinguish it from natural corundum. This process[2], started in 1901, has proved quite successful, the output in 1904 being 1,800 tons, practically all of which was used in the manufacture of grinding wheels and other abrasive articles. The fused product is characterized by its toughness and hardness, and is said to possess superior qualities to those of the natural material.

At Rheinfelden a similar product is being manufactured, but is called "diamantin"; the Goldschmidt "thermit" companies are also employing as an abrasive the fused alumina which occurs as a by-product of the processes which they carry out.

Of more direct interest is the application of fused alumina to the production of a new "pottery body." This development has been carried out by an important German firm of potters (Deutsche Steinzeugwaarenfabrik, of Friedrichsfeld) in conjunction with a leading chemical works.[3] Articles made from this new material are said to possess to a remarkable degree the power of withstanding sudden heating to a high temperature. This is due to the very small contraction which occurs in articles made with suitable mixtures of the fused alumina and clay.

It would indeed be of interest to know the relative behavior of other completely "shrunk" oxides, etc., when used in a similar manner; by actual fusion in the electric furnace these materials can be obtained in a condition in which subsequent heating causes no further contraction. The strength of bodies made of such materials when subjected to severe thermal treatment probably depends much more upon the completeness of this "shrinking" than upon the thermal conductivity.

Magnesia—Since magnesia is the most refractory of the commonly occurring oxides, it is surprising that it is not more widely employed for the construction of vessels capable of withstanding high temperatures. Up to the present, however, ordinary calcined magnesia has been found none too well suited for this purpose. Magnesia bricks, crucibles, etc., of nearly all makes require very great care in handling, and it is particularly necessary in furnace work to heat them evenly and slowly, otherwise fracture occurs.

Recently the electric furnace has been used to fuse or shrink magnesia,[1] and much may be expected by the application of such products for the manufacture of crucibles, etc.

Pure magnesia tubes and other vessels of small size are now made by the Royal Porcelain Factory at Berlin, but, on account of their high cost, are obviously of greater importance for scientific than for technical work.[2] There is, however, nothing to hinder the cheap production of electrically shrunk magnesia on a large scale, so that further developments along these lines may confidently be expected.

Arc furnaces very similar in general type to those employed in the manufacture of calcium carbide have been used technically for the production of fused alumina and magnesia, and, where it is desirable to produce a really fused and liquid product, there are somewhat great difficulties in the way of using a resistance furnace with material packed around a central core. On the other hand, much can be done with resistance furnaces, and large masses of magnesia can be heated to near the melting point, and caused to recrystallize, with a very simple type of furnace, and with considerably lower power expenditure than is incurred with the arc type of furnace.

Silica Glass—The fusion of quartz has within the last few years shown signs of developing into a flourishing little industry.

The quartz fibres of Boys were followed by the tubes and small vessels of Shenstone, but in both cases it was the oxy-hydrogen blowpipe which served as the source of heat. The working of the material was consequently both tedious and expensive.

Recently the electric furnace has been called into service with most satisfactory results. Relatively large tubes have been obtained from quartz crystal or Calais sand, both by indirect heating with the electric arc and also by passing the electric current through a carbon core surrounded by sand.[1] Recently the electrical process has been developed, and a method discovered for blowing and shaping vessels from the semifluid material, produced around an electrically heated core.[2] With these and other improvements, the Thermal Syndicate, of Wallsend-on-Tyne, is producing large pipes, bricks, dishes, insulators, pyrometer tubes, and a variety of other ceramic articles.

The fused silica has most valuable properties; not only can it withstand extreme and sudden changes of temperature, but its highly refractory nature and extreme hardness should also assure it numerous applications in the chemical and other industries.

On account of the inclusion of small air bubbles in the plastic mass, and the impossibility of bringing silica into a really fluid condition, up to the present time a perfectly transparent material has not been obtained in large masses. The translucent nature of the product will, however, enable it to be used for many purposes in addition to those mentioned above.

Conclusion—Owing to the fact that many of the industries which have been considered are in such an early stage of their development, it is scarcely wise to try and point out directions in which they are likely to progress. The brief indications which have been given are intended simply to draw attention to a subject which should not be altogether unworthy of the consideration of those interested in the ceramic industry.

I am most anxious to record my deep indebtedness to Dr. Mellor for the kind help which he has given me throughout in the preparation of this paper, and to the electricity department of the Hanley Corporation for the excellent facilities which they have given me for illustrating the paper by demonstrations with the Moissan furnace.

1 A. Verneuil, *Ann. Shim. Phys.*, (8), 3, 20-48, 1904. For historical account see H. Marour. *Revue chim. pure et app.*, 6, 72-77, 1903.
2 C. B. Jacobs, Eng. Pat. 16,529, 1900; A. C. Higgins, U. S. A. Pat. 775,654, 1904.
3 Max Buchner, *Loc. cit.*

1 See E. K. Scott, *Trans. Faraday Soc.*, 1, 289-304, 1905.
2 For results of tests of these vessels see K. Arndt, *Chem. Zeit.*, 30, 211,, 1906.

1 R S. Hutton, *Mem. Manch. Lit. and Phil. Soc.* 46, vl., 1-5, 1901; *Trans. Amer. Electrochem. Soc.*, 2, 105-111, 1902.
2 Engl. Pat. 10,670, 1904.

RESULTS OF INVESTIGATIONS ON LIGHT STANDARDS.[1]

BY CLIFFORD C. PATERSON.

Investigations were undertaken two years ago at the instigation of the Institution of Gas Engineers, of Great Britain, with the object of determining the ratio between the candle powers of the three principal standards as used by the gas industries at the present time in France, Germany and Great Britain. The author desires to acknowledge the kindness of the Institution of Gas Engineers in allowing the publication, in this paper, of the main features of the report which was submitted to them eighteen months ago, and which they have only refrained from publishing earlier at the request of the International Photometric Commission.

This commission, on which the Institution of Gas Engineers is represented, arranged for similar tests to be made in France and Germany in order to obtain a set of independent comparisons which shall enable the ratios between these standards to be defined with more certainty and greater accuracy than at present.

The results of tests in France and Germany, although completed more recently, have already been published,[2] and a comparison of the figures is exceedingly interesting as showing the order of agreement which has been obtainable in the photometric measurements made by separate observers working under different conditions with different apparatus.

A detailed comparison of the methods adopted in carrying out the tests can not usefully be made until the full report of the commission has been published, but the results of the tests in the various laboratories are here tabulated and compared.

The standards to which reference has been made are respectively the Carcel, the Hefner, and the ten-candle-power Harcourt pentane lamps. In all measurements special care was taken in the manipulation of the lamps so as to conform to the same regulations and practice which are observed in the countries in which they are the recognized standards.

In summarizing the results of the tests, and comparing them with those made in other laboratories on the Continent, it is essential to take into consideration the fact that the Hefner lamp in Germany has its standard value when the volume of water vapor is 8.8 per 1,000 litres of air, whereas both the pentane and Carcel lamps are taken as having their nominal value when the humidity is ten litres per 1,000.

The following values were obtained for the Hefner and Carcel lamps. These values are in the terms of the ten-candle Harcourt pentane lamp. In the case of the Carcel standard the mean of all the readings has been taken. The variations of the Carcel lamp with changing humidity will hardly concern these figures, since all measurements were made in the neighborhood of ten litres per 1,000.

Hefner lamp = 0.914 pentane units.

Carcel lamp = 0.982 pentane units.

The following tables give the values for the same ratios recently obtained and published[1] by the Reichsanstalt in Berlin, and by the Laboratoire Centrale d'Electricité and Laboratoire d'Essais et Conservatoire in Paris.[2]

Expressing the values of all the units in terms of that given by the pentane lamp, we have:

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1	0.914	0.982
Reichsanstalt	1	0.917	0.991
Laboratoire Centrale....	1	0.929	1.000
Laboratoire d'Essais....	1	0.928	0.996

Expressed in terms of the unit given by the Hefner lamp they are as follows:

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1.094	1	1.074
Reichsanstalt	1.09	1	1.080
Laboratoire Centrale....	1.076	1	1.076
Laboratoire d'Essais....	1.077	1	1.067

Expressed in terms of the unit given by the Carcel lamp:

	Pentane.	Hefner.	Carcel.
National Physical Laboratory	1.018	0.931	1
Reichsanstalt	1.009	0.926	1
Laboratoire Centrale....	1.000	0.929	1
Laboratoire d'Essais....	1.004	0.937	1

These results show that in entirely independent comparisons of flame standards in Paris, Berlin and London, the maximum difference between London and Berlin was one per cent, between Paris and Berlin was 1.7 per cent, and between London and Paris 2.1 per cent. It should further be remarked that the discrepancies may to some extent be accounted for, leaving a smaller residual error to be attributed to unexplained causes.

COMPARISON AND CRITICISM OF THE THREE LAMPS AS STANDARDS OF LIGHT.

The measurements made at the National Physical Laboratory on the three principal flame standards now in use have given opportunities for comparing them under working conditions and judging of their respective suitability as standards of light.

As regards the Carcel lamp, it has not been found that its constancy from day to day is comparable with that of either the Hefner or pentane lamps, its variations from the mean being as much as + or — three per cent. The reason for this can only be attributed to the difficulty in reproducing the same conditions of capillarity in the wicks used. Although all possible care was taken to produce the most favorable conditions of constancy, the results were not satisfactory, and in the notes which follow, the pentane and Hefner lamps only are considered with reference to their suitability as light standards.

General Construction — The Hefner lamp, which is only one-eleventh the candle-power of the pentane lamp, is much simpler in general construction, small and more easily set up, and should be simpler to manufacture and adjust to standard dimensions.

Ease of Regulation and Working—It has been found in using the lamp that the flame of the ten-candle pentane standard is a great deal easier to adjust, and remains more constant while observations are being made than that of the amyl-acetate lamp.

The fact that the Hefner unit has a lambent flame, burning in free air, whereas the pentane standard is well shielded and, owing to its chimney, has a more stable flame, makes the latter practically independent of drafts, which would render measurements with the Hefner lamp quite impossible. Although the flame of the Hefner lamp may be shielded, slight movements of the air can not be avoided; these disturb the flame so that it only remains at its correct height for a few seconds together, rendering adjustment difficult and the taking of candle-power readings rather a tiring process.

On the other hand, it is not safe to assume that, owing to the fact that the top of the flame of the pentane lamp is cut off, the latter may be allowed to vary appreciably in height. Variations of three millimetres up or down do not materially affect the candle-power, but for accurate work a second observer is required to see that the top of the flame is flat, and to regulate it to the correct height.

Effect of Atmospheric Changes—As regards changing humidity, the two standards are affected to nearly the same extent, the Hefner lamp being slightly less influenced than the pentane lamp. The latter standard, however, is very much more sensitive to barometric variations than the Hefner unit, an inch change in

[1] From a paper entitled "Investigations on Light Standards and the Present Condition of the High-Voltage Glow Lamp," read before the Institution of Electrical Engineers of Great Britain, January 24.

[2] Bulletin de la Société Internationale des Electriciens, No. 58, vi, 1906. "Etude sur le Rapport des trois lampes Carcel, Hefner, et Vernon Harcourt," par MM. Laporte et Jouaust. Also Extraits du Rapport presenté à la Commission Internationale de Photometrie par M. Perot et M. P. Janet.

Journal für Gasbeleuchtung, 1906. "Photometrische Versuche," etc., by Dr. Emil Liebenthal.

[1] *Ref. cit.*

[2] The values for the three ratios given by the Laboratoire d'Essais differ among themselves by about 1 per cent. The mean values have therefore been taken.

pressure being equivalent to two per cent in candle-power.

The Nature of the Light—The pentane lamp has a whiter light than the Hefner unit, being much more nearly the same tint as the Carcel standard.

The fact that its candle-power is eleven times that of the amyl-acetate lamp makes it of the same order of magnitude as the ordinary lights which are tested against it.

These two factors, coupled with the greater ease of adjustment when making observations with the pentane lamp, greatly outweigh, in the author's opinion, the disadvantage of the more complicated construction and the larger correction that has to be applied for changes in barometric pressure.

SECONDARY STANDARDS OF LIGHT.

Tests were made at the National Physical Laboratory on a number of high-voltage standard electric lamps in order to ascertain what order of constancy may be expected from the best high-voltage glow lamps, with a view to using them as photometric standards.

Ten of these lamps were obtained two years ago from the Ediswan Company, for use as laboratory standards. They were mounted on fixed sockets with soldered leads. They were run for periods varying from 400 to 600 hours on a circuit, the pressure of which was carefully regulated. Candle-power readings were taken at frequent intervals during the run. The efficiency of these lamps was initially about 4.5 watts per candle and 4.3 after 500 hours. When compared with the life curves of ordinary lamps, it was noticed that the initial rise in candle-power lasts over a long period. The best result was that of a lamp which remained constant for 200 hours. In the case of one lamp there was no sign after 600 hours of any diminution in the rapid rate at which the candle-power was rising.

The first point which is evident from an inspection of these curves is that the performance of filaments specially prepared for constancy can not be predicted with certainty. If a lamp is to be used as a photometric standard of the first grade, its history for 100 to 200 hours should be known, and its life curve should be closely watched in order to ascertain the point at which it is beginning to flatten out.

If the only photometric standards required were of the low-voltage type, the problem might be considered as solved. A properly aged, specially prepared, low-voltage filament if burnt for, say, ten minutes a day for five days in the week, should last two or three years without changing the half of one per cent in candle-power, provided that no excess voltage is applied.

Where, however, the only source of supply is a high-voltage variable circuit, it is essential that the standard and the test lamp shall be run in parallel, so that the effect of voltage variations may be reduced to a minimum. This entails either the use of a low-voltage lamp with a fixed resistance in series, or a high-voltage lamp of reasonable constancy. The method of putting a resistance in series with a low-voltage lamp and running on a high-voltage circuit is not so satisfactory as it might appear at first sight. The resistance must dissipate some sixty watts and must keep constant to 0.1 per cent if the candle-power is to be correct to 0.5 per cent. If, further, the voltage variations on the circuit are great it is essential that the temperature coefficient of the resistance shall be the same as that of the lamp.

In the tests under consideration six lamp makers kindly undertook to cooperate with the laboratory in the investigations, by supplying high-voltage sixteen-candle-power lamps, with filaments which they considered would be most suitable for standard purposes. The filaments were in one plane and the bulbs of ample dimensions. The lamps numbered in all thirty-seven, and were run on a pressure-regulated circuit with frequent observations of candle-power and current.

The average rate of fall in candle-power for each make of lamp is given in Table II, as well as its average efficiency. The figures in column 4 are taken from the portion of the curve at which the rate of fall is most even.

TABLE II.

Column 1. Make of Lamp.	Column 2. Number Tested.	Column 3. Average Initial Watts per Candle.	Column 4. Percentage Fall in Candle-Power per 100 Hours.
A	5	3.4	4.6
B	4	4.2	0.9
C	3	4.1	1.7
D	8	4.0	3.7
E	11	4.5	2.9
F	6	3.7	3.5

Make A has an initial efficiency which is unnecessarily high for standard work, but except for one lamp the life curves do not differ from those of ordinary filaments of high-grade quality.

Make B shows an interesting set of freak curves. The candle-power of one lamp, with an efficiency of four watts per candle, has remained constant for over 300 hours to within the half of one per cent. This lamp shows, of course, the best performance, and is the type to be aimed at—but it is, unfortunately, the only one of its kind out of some five or six which have been tested. Other lamps of this type gave a characteristic which, after falling and again rising in candle-power, finally reached an approximately constant value after 500 hours.

Make C has some interesting features. Only three lamps were tested of this kind, but of these, two show a high degree of constancy over a portion of their life—especially as they have the comparatively high-efficiency, for 200-volt standards, of four watts per candle.

Makes D and F show no special features of interest, as they have an even fall in candle-power throughout the whole of their life.

Make E. The foregoing remarks apply to Make E also, except for one lamp, burning at four and one-half watts per canlle, which shows but a very gradual fall in candle-power.

As a result of these investigations there is no doubt that high-voltage standard lamps are to be obtained which remain constant for a considerable time. They can not, however, as yet be produced with certainty. By trying a number of special lamps, some may be found which are in every way as good as low-voltage standards—but at present the only alternative to this is to select a lamp with as small and as regular a drop as possible, and rely on restandardization after about twenty hours' running. It should not be necessary to run a standard under ordinary conditions for longer than forty-five minutes per week in all. In this case restandardization would only be required every six months.

Important Engineering Fellowships.

Ten research fellowships of the annual value of $500 each have been established in the engineering experiment station connected with the College of Engineering of the University of Illinois, Urbana, Ill. Graduates of American and foreign schools of technology are eligible for appointment to these fellowships, the establishment of which marks the adoption of an important departure in American technical education, namely, the establishment of graduate work in engineering on a plan and scale here accepted for the first time. It indicates the beginning of graduate work in the true sense in the field of engineering, that is, investigative and research work carried on by men who have already taken their degrees in engineering. The fact that foreign students are also eligible is a significant departure, as this will enable the engineering experiment station to draw not merely upon American schools but upon the best of foreign schools for their most capable graduates, thus uniting the benefits of foreign and American technical training in the best combination possible.

THE TECHNICAL GRADUATE AND THE MANUFACTURING COMPANY.[1]

BY CHAS. F. SCOTT.

The changes which have occurred in the lifetime of the young men of the present day surpass in many features those which have occurred during many centuries. The rate of progress, moreover, is an accelerating rate. The value of the manufactured products of the United States has doubled in less than twenty years. This is significant of a new order of things. Engineering is not only the basis of this material change, but it is also the underlying condition which has brought about the new political, economic and social evolution. These facts are well known. They have come to be regarded as almost commonplace. It is important, however, that we realize their significance in order that we may better understand the present tendencies and anticipate the qualifications which the future engineer should possess.

Two institutions have grown up within the past few years, with which we are very intimately concerned. These are the technical school and the large manufacturing company. In engineering education the ideals, the methods and the facilities are all new. The engineering graduate is a new product. He is a new factor in the world's work.

Educational methods are not fixed and definite. They are vastly different from those of a generation ago, and the engineering educational methods of the near future may be quite different from those of to-day.

Closely related to this development in engineering education is that of the manufacturing company. In electrical engineering, in particular, the growth of the school and of the industry has had a close relationship. Each has been, to a greater or less degree, dependent upon and aided by the other. In the days of our fathers, manufacturing was carried on in a small way, usually one man was at the head of a given business, personally familiar with and directing its various departments. He devised processes, directed the manufacture and was his own sales agent. Modern manufacturing, however, is of a different kind. The various functions formerly performed by one man require the cooperation of many men in a single organization. Each is an expert, and altogether they act as a powerful unit.

Thus, cooperation—or the corporation—has become the modern method. It is the method, moreover, by which modern engineering is conducted. Enterprises, except those which are small or of a particular kind, can not be conducted by a single individual. The collaboration of many men is required for larger undertakings. Hence the necessity of the engineer being able to work efficiently with others.

The large electrical manufacturing company is typical of modern manufacturing and business methods. It may be noted that the products of the electric companies, which are now produced in values exceeding a hundred million dollars a year, would have had no market thirty years ago, as they would have been practically useless. The work of these companies, in general, is broad in its scope; it includes invention, development, design, manufacture and erection, as well as the sales and financial departments. To carry on this work such companies are divided into many departments. Technical men find their field in those departments which are concerned with engineering, either directly or indirectly, and, furthermore, the engineering training is found in many cases to be an excellent preparation for those engaged in more purely executive work.

There was an old-time idea that the theoretically trained young man was completely equipped for doing engineering work and that he was at fault if he was not immediately prepared to produce efficient results. This view, however, is based upon several misconceptions. First of all is the relation between knowledge and experience. One may know his theory and his formulæ, but engineering problems are not abstract, they are concrete. They deal not merely with forces but with materials. One must know the constants of his materials and the uses of the products. These come from experience. The designer of apparatus must not only know the theoretical principles which are involved, but he must know the various qualities, electrical and mechanical, of the many materials which he must use. He must be familiar with the methods of using these materials and the manufacturing facilities which will insure cheap and rapid production. He must be familiar with the service conditions so that he may design apparatus which will not only meet reliably the electrical and mechanical requirements of normal operation, but which will safely withstand the emergency conditions which are liable to arise. His apparatus must be adapted to the class of men who will use it. It must work properly with the other apparatus in the system in which it is to be placed. It must, in short, meet commercial conditions in a manner which will prove acceptable to those who purchase it. A gain of a per cent in efficiency or in regulation is of minor consequence if a machine has bad bearings which overheat. It follows, therefore, that even the designer, who has probably more to do with theory than those in any other department, has to be familiar with many other points besides his theory. Experience, creative imagination, foresight as to the effects of new combinations and new forms, good judgment, integrity, not only with people but in dealing with facts, tact and the ability to get along comfortably and efficiently with other people, together with a goodly measure of all-round common sense, are qualities which must supplement the knowledge of formulæ in order to effect the best results.

Those who are engaged in testing departments, in inspection, in erection, as well as in the various departments of commercial engineering and sales, require in a large measure the same breadth of view and qualities which have just been enumerated.

The manufacturing companies have recognized that the man immediately from college requires a further training. He needs experience, a new point of view. Engineering apprenticeship courses are therefore arranged in which he may gain familiarity with manufacturing and testing operations and also, what is of scarcely less importance, an immediate knowledge and acquaintance with the working together of many men in a great organization.

Young men in college are devoting their energies to preparation for their life work. It behooves them to expend their efforts as efficiently as is possible. They will do well first of all to learn fundamental principles, to gain theory not merely in the abstract but through their laboratory work to gain a concrete physical understanding of these principles. A knowledge of specific things, such as particular kinds of apparatus or the characteristics of special materials used in manufacturing processes, is of less consequence. Practice changes; principles do not. The student must not emphasize knowledge as distinguished from training. Training, which enables him to use his knowledge, is of first consequence. The man who is trained in observation, whose logical and reasoning powers are alert, who is able thereby to efficiently apply the knowledge which he has, will probably be much more effective and successful than his companion, who may know more but can do less. A skilful workman with poor tools can accomplish

[1] From *The Wisconsin Engineer*, based on a lecture delivered at University of Wisconsin, November 7, 1906.

more than a mediocre workman with the best of tools. Many of those who select college graduates look for the successful leaders in student organizations rather than those who head their classes. The man who combines both kinds of leadership gives especial promise. Many students do not get this broader view of their work. They do not apply engineering methods to themselves. Each man may well consider himself as a machine, as something with which to produce results. He should study how he may produce the best results with the least effort. Many are already quite proficient in so far as the "least effort" is concerned. The real problem, however, is with reasonable effort to produce maximum output. It is probable that some who have seemingly expended but little effort have learned to work with greater efficiency than the plodders who have received better class-room reports but with a vastly greater expenditure of effort. The man who has learned to handle himself and to work efficiently has a vast advantage when he does apply himself. This is one reason why college grades do not give a true indication of future careers.

If students can take this larger, broader and more serious view of their work, giving attention to the understanding of principles rather than the knowledge of facts, and recognizing that the training in the use of their powers is of scarcely less importance than the acquisition of these powers, then the college graduate will become a more successful man both from his own standpoint and that of usefulness to others.

Boiler Explosions During 1906.

The following article is abstracted from *The Locomotive,* Hartford, Ct., January:

"We present, herewith, our usual annual summary of boiler explosions, giving a tabulated statement of the number of explosions that have occurred in the United States (and adjacent parts of Canada and Mexico) during the year 1906, together with the number of persons killed and injured by them. As we have repeatedly explained, it is difficult to make out accurate lists of boiler explosions, because the accounts that we receive are not always satisfactory; but, as usual, we have taken great pains to make the present summary as nearly correct as possible. It is based upon the monthly lists that have been published in *The Locomotive* during the past year; and in making out these lists it is our custom to obtain several different accounts of each explosion, and then to compare these accounts diligently, in order that the general facts may be stated with a considerable degree of accuracy. We have striven to include all the explosions that have occurred during 1906, but it is quite unlikely that we have been entirely successful in this respect, for many accidents have doubtless occurred that have not been noticed in the public press, and many have doubtless escaped the attention of our numerous representatives who furnish the accounts. We are confident, however, that most of the boiler explosions that have attracted any considerable amount of attention are here represented.

"The total number of boiler explosions in 1906, according to the best information we have been able to obtain, was 431, which is nineteen fewer than were recorded for 1905. There were 450 in 1905, 391 in 1904, 383 in 1903, and 391 in 1902. In several instances during the year 1906 two or more boilers exploded simultaneously. In every case of this sort we have followed our usual practice and counted each boiler separately in making out the summary, believing that by so doing we should represent the actual damage more accurately than we should if we simply recorded the number of separate occasions on which boilers have exploded.

"The number of persons killed in 1906 was 235, against 383 in 1905, 220 in 1904, 293 in 1903, and 304 in 1902; and the number of persons injured in 1906 was 467, against 585 in 1905, 394 in 1904, 522 in 1903, and 529 in 1902.

"The average number of persons killed, per explosion, during 1906, was 0.545, and the average number of persons injured but not killed, per explosion, was 1.083.

"During the year 1906 there were a number of very serious explosions, but none that would compare, in regard to the number of persons killed, with the fearful explosion at Brockton, Mass., in 1905, nor with that on the U. S. gunboat 'Bennington,' in the same year."

The Annual Report of the Chesapeake & Potomac Telephone Company.

The annual report of the Chesapeake & Potomac Telephone Company for the year ended December 31, 1906, shows gross earnings of $2,452,076.41. The net operating earnings were $441,098.37. After deducting interest, the balance to surplus amounts to $75,681.72. The number of telephone stations in service was 70,167, a net gain for the year of 17,547. These were distributed as follows: Washington, 27,043; Baltimore, 31,155; scattering, 11,969.

The work of extending and enlarging the company's equipment, particularly in Baltimore and Washington, was actively prosecuted. The underground conduit system was extended by the addition of 108,452 feet of conduit comprising 423,298 feet of ducts. In Washington the capacity of the various central offices already established was considerably increased, and the construction of a new central office, to be known as the Lincoln exchange, was almost completed. In Baltimore the new St. Paul exchange was successfully opened early in the year, and additional equipment was installed in several other offices.

In the territory outside of the District of Columbia and the city of Baltimore, comprising all of Maryland west of Chesapeake bay and the Susquehanna river, and the adjoining part of West Virginia, extensive improvements in the plant and business were made. Nineteen central offices were established or acquired, 402 miles of exchange poles erected, and 5,462 miles of exchange wire placed. The interurban trunk-line plant was also greatly extended, seventy miles of pole lines and 1,440 miles of wire having been added during the year. In addition to private plant to serve and join together the several cities, towns and villages in the territory, lines have been extended to various relatively sparsely settled mining and agricultural sections.

The number of employés in service was decreased by forty-eight during the year, making a total of 2,382, of which 1,405 were men and 977 women.

American Union Telephone.

The American Union Telephone Company, which represents all the merged independent telephone companies of Pennsylvania, southern New York, Maryland, northern Virginia and West Virginia, will expend $2,685,000 for improvements to the system. Through traffic agreements and connections with other telephone companies for long-distance service have been made.

The company covers about one-third of the territory of the United States, containing more than half of the population of the country. Included in the new company is the Union Telephone Company. Announcement has been made that the general office of the Union company has been moved from Erie to Harrisburg, Pa., where it will be merged with the new company. The company was incorporated last May, with principal offices in Harrisburg.

Annual Report of the Trustees of the Mackay Companies.

The trustees of the Mackay Companies make the following report to the shareholders for the year 1906:

"The Mackay Companies owns the whole or part of the capital stock of 102 prosperous cable, telephone and telegraph companies in the United States, Canada and Europe, including the entire capital stock of the Commercial Cable Company and the various companies constituting the land-line system, known as the Postal Telegraph. It is the policy of your trustees to make the basis of the Mackay Companies so broad and diversified as to render impossible any fundamental impairment of the preferred or common shares. Accordingly, your investments include stocks in submarine cable companies in the Atlantic and Pacific oceans, and in the Postal Telegraph land-line system, and in dividend-paying stocks in the best telephone companies. The Mackay Companies is by far the largest stockholder in the American Telephone and Telegraph Company, commonly known as the Bell Telephone Company, its holdings being more than four times those of any other stockholder in that company. Your trustees believe that the present friendly relations with that company should be cemented in the interest of the shareholders of both companies and also of the public at large.

"Notwithstanding these days of money borrowing and mortgage giving, your trustees are again able to announce that the Mackay Companies has no debts.

"Its authorized capital is $50,000,000 preferred shares and $50,000,000 common shares, of which there are outstanding $50,000,000 preferred shares and $41,380,400 common shares. During the past year $9,354,400 preferred shares have been issued in exchange for stocks of corporations, which, in addition to strengthening the position of the Mackay Companies, pay as much or more dividends than the corresponding dividends paid on the Mackay Companies' preferred shares. The entire authorized preferred shares of the Mackay Companies have now been issued, and no further preferred shares may be issued, excepting on a vote of the shareholders. The outstanding common shares have not been increased during the past two years. The Mackay Companies, in its investments, confines itself to first-class cable, telephone and telegraph stocks.

"The shares of the Mackay Companies were listed on the New York Stock Exchange on January 23, 1907.

"Dividends have been regularly paid on the preferred shares since April, 1904, at the rate of four per cent per annum, payable quarterly. Dividends have been regularly paid on the common shares since January, 1905, such dividends having been increased to four per cent per annum, payable quarterly, commencing July, 1906.

"The income of the subordinate companies of the Mackay Companies is largely in excess of the amount required to pay these dividends, but its policy is to obtain from its subordinate companies only enough money to meet the dividends on the Mackay Companies' shares. If the entire profits of the Commercial Cable Company and its land-line system for 1906 were paid to the Mackay Companies, as might legally be done, and if the Mackay Companies used all these profits, together with its income from other investments, for the payment of dividends, the amount would be sufficient to increase very largely the present dividend on the common shares, after paying the full dividend on the preferred shares. All surplus earnings are left in the treasuries of the subordinate companies for extensions and the development of the business and the increase of reserves.

"During the year 1906 the earnings of the Commercial Cable Company (which has paid regular quarterly dividends for over seventeen years) have shown substantial gains in gross receipts and net profits, on both the ocean and land systems. After paying the dividend on its stock, a large amount remaining was carried to reserve, in accordance with its long-established policy. The Commercial Pacific Cable Company, during the year 1906, laid submarine cables to China and Japan, and those cables are now in complete working order. The land-line system (the Postal Telegraph) is being constantly extended, and also shows substantial increased gross receipts and net profits over the previous year. On December 6, 1906, the forty-year monopoly of all telegraphic and cable business between Cuba and the United States, granted by the Spanish Government in 1866 to the International Ocean Telegraph Company, and later acquired by the Western Union Telegraph Company, came to an end by the expiration of the forty years. Your trustees, deeming it important that that part of the world should also be reached by your cable and telegraph system, applied to the American governor in charge of the provisional government of Cuba for the usual permit for the landing and operation of a submarine cable between the two countries and such permit has just been granted. The first plan of your trustees was to pursue the same route as that of the Western Union Telegraph Company; namely, a land-line system from New York city to Florida and a submarine-cable system from Florida to Havana. In order, however, to make this Cuban service equal to the service of the Commercial Cable Company in the Atlantic ocean, and the Commercial Pacific Cable Company in the Pacific ocean, and the Postal Telegraph Company throughout the United States, your trustees have decided to lay a submarine cable direct from New York city to Havana, thereby giving a three-minute service as against an average thirty-minute service. The entire cost of this important extension to Cuba will be paid out of current profits.

"The cable and land-line systems have, during the past year, inaugurated and put into successful operation a plan whereby the employés of the organization are given an opportunity to purchase preferred shares in the Mackay Companies, and to make payments therefor by instalments. A large number of the employés have availed themselves of this opportunity, and the plan has been so successful that arrangements have been made to continue it in order that the relations between the employés and the companies may be that of cordial cooperation and mutual benefit and support."

Following is the profit and loss account of the Mackay Companies for the year February 1, 1906, to February 1, 1907.

RECEIPTS.

Income from investments in other companies		$3,310,327.93

DISBURSEMENTS.

Dividends paid to to shareholders of the Mackay Companies	$2,985,874.00	
Operating expense, including transfer agents, registrars, and trustees' compensation, office rent, salaries, stationery, engraving of certificates, listing of shares on New York Stock Exchange, etc.	24,624.83	
Balance carried forward	299,829.10	
		$3,310,327.93

ASSETS.

Investments in other companies	$91,887,487.90
Cash	220,459.32
	$92,107,947.22

LIABILITIES.

Preferred shares issued	$50,000,000.00	
Common shares issued	41,380,400.00	
Surplus	727,547.22	
		$92,107,947.22

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Telephone System of the Sewerage Plant at Schöneberg, Germany.

An all-cable telephone system was installed recently in connection with the municipal sewerage plant of Schöneberg, Germany, of which a description is given here by Alfred Gradenwitz. While it is often desirable to place telephone cables underground, thus protecting them from frost and damage to overhead structure, an objection is the cost of laying the ducts. This may be avoided, as in the present instance, by laying the lead-sheathed cable in the trench alongside the sewage pipes. There is no expense for excavation, and the pipe itself serves as a protection. As the telephone lines of this system were rather long, the Pupin system of loading was adopted. Small coils were placed in iron cases and introduced into the cable. In this case, since the cable itself is laid close to a large iron pipe, it was allowable to reduce the size of the coils, as the pipe itself increased somewhat the inductance of the line. Thus it has been possible to secure satisfactory telephone communication over lines thirty miles in length. In one or two places short lengths of duct were laid, as it was necessary to put the high-pressure water pipes into service before the cable had been received. The cables are connected to a small switchboard at the headquarters of the sewerage system.—*Abstracted from the American Telephone Journal (New York), February 9.*

The Electric Light, Power and Heating System of the University of California.

The light, heat and power system of the University of California presents some interesting features. When the heating plant was installed, light and power equipment was also added; but the peculiar character of the load called for by the university enabled the California Gas and Electric Corporation to make a very low rate for electric power, the agreement being that this should be used only when the other demand on the company's power line was light. The rate offered was less than the cost to the university of generating its own power. Partly for this reason, and partly because the greater part of the power is used at the engineering laboratories, which are somewhat separated from the heating plant, a transformer substation was placed near the laboratories and connected to the generating room by the high-tension lines. Power is received at 4,000 volts, three-phase, and transformed to 2,000 volts, two-phase, by means of two seventy-five-kilowatt, oil-cooled transformers. From the transformer substation power is distributed by an underground conduit system to all the buildings on the campus. As there is a considerable demand for direct current at 220 and 110 volts, a fifty-horse-power induction motor was installed in the engineering building, which drives two twenty-five-kilowatt, 125-volt generators for this purpose. The generating room contains a forty-five-kilowatt, 125-volt, direct-current generator and a forty-kilowatt, two-phase-three-phase alternator, both direct-connected to high-speed engines. The fuel used is oil.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), February 2.*

Electricity and Destructor Works.

The results accomplished with the refuse destructor in a small town of about 20,000 inhabitants are discussed here by A. J. Abraham. Averaging the results which have been obtained in a number of such towns, the amount of refuse destroyed annually was 4,680 tons, and the number of kilowatt-hours generated was 200,000. In Cambuslang, where the destructor and the electric lighting station are run together, seventy-two tons of refuse are destroyed each week, from which 2,520 kilowatt-hours are generated. Only 716 kilowatt-hours are generated by the use of coal. This is in spite of the fact that no battery is installed at the station for balancing the load. These figures show that thirty-five kilowatt-hours are generated for each ton of refuse destroyed. With a battery the author believes that it would be easy to obtain fifty kilowatt-hours per ton of refuse, and he thinks it is safe to allow an average of forty for all properly constructed stations working with refuse destructors. It is advised that the boiler be worked at a steam pressure of 200 pounds per square inch, which would be reduced to 150 pounds at the engine. A good-sized storage battery is a necessity. Out of the 200,000 kilowatt-hours to be generated in a small town burning 4,680 tons of refuse, 187,200 kilowatt-hours may be generated from the refuse. This would mean a saving of about $2,000 in coal. Combined power-stations and destructor works for larger towns of from 40,000 to 50,000 inhabitants have in all cases been a failure, and the more the load on the station increases, the greater is the necessity for moving the destructor away. At Hackney, with a population of over 200,000, it cost about $11,000 to generate 1,500,000 kilowatt-hours from refuse, and only $5,900 to generate 1,470,000 kilowatt-hours from coal. At Preston a destructor is working very satisfactorily in conjunction with a street railway power station. Were this destructor combined with the electric light plant the results would not be so satisfactory. The relative advantages and disadvantages of the two types of destructor—that is, the top feed and front feed—are given as follows: The top feed is more expensive to work than the other, because, when steaming, men are required both on top and at the fires in front. With the front-feed destructor the same men can stoke and clinker out, reducing the labor cost to almost half. The refuse tipped on the hot cell tops is a nuisance and is unhealthy. The work of pushing the fuming material into the top doors is very disagreeable. Moreover, these doors are troublesome to keep in order. On general principles, the fewer openings there are in a cell, the better, as it is not advisable to have any openings in the furnace crown. Using a front feed there is no objectionable odor, the destructor is more easily worked, and in many cases it is actually a disadvantage to dry the refuse before burning it, as much of the calorific value is lost thereby.—*Abstracted from the Electrical Review (London), February 1.*

Recent Progress in X-Ray Technic.

A review of recent progress in the technics of X-ray work is given here by H. L. Jones. The induction coil is still almost universally used as the most convenient instrument for obtaining the high potentials required to excite the tube. In the construction of the coil the weight of

iron in the core has been considerably increased, and the primary windings are now arranged in sections for series or parallel connection, so as to adapt the coils for use with interrupters of various degrees of frequency. The twelve-inch induction coil has become the standard in England to-day, but it is probable that it will soon be replaced by eighteen or twenty-inch coils. The advantage gained by the use of such large coils is that very rapid exposures suffice for photographic work, so that negatives may be taken before the target of the tube has become overheated, and instantaneous pictures of the heart and lungs may be obtained. When using the large coils it has been found that occasionally the insulation gives way, apparently due to the formation of nitric acid from brush discharges. The trouble always occurs in the low-voltage primary winding, which is not usually embedded in a solid insulator. The chief defect of the induction coil is that it does not give unidirectional currents, and when the coils are operated directly from the supply system, the inverse currents at "make" acquire an increased importance and act injuriously by shortening the life of the tube and spoiling the definition of the picture. In modern practice a valve tube is used for suppressing this inverse current. One of the best of these is that of Villard, which is a form of Geissler tube with an open spiral of aluminum wire for the cathode. This works very well even under high voltages. Practically no leakage takes place. Among interrupters, the vibrating hammer has practically fallen into disuse, except for coils intended for transportation to the bedside; and even for this work it is being superseded. A great variety of motor-driven interrupters employing mercury jets are in use, and have some advantages. One ingenious form requires no motor, the rotation of the pump being effected automatically by the current passing through the interrupter to the coil. On the cover of this instrument four short, straight electromagnets are fixed. The current, in traversing these, exerts a pull on a star-shaped, soft-iron armature attached to the axis of the pump, and keeps it in rotation. The apparatus is set in motion by a touch of the finger. The speed is controlled by shunting the magnet windings. It is quiet in action, simple to clean, and can be used on circuits up to 240 volts. For hospital purposes, where frequent cleaning is necessary, the Wehnelt interrupter serves better. At St. Bartholomew's Hospital an interrupter of this kind is fitted up in an earthenware foot-bath holding several gallons of liquid. This makes it possible to keep the interrupter in action for the whole of an afternoon without any trouble from overheating. The Wehnelt interrupter wastes much current and imposes a rather severe strain on the tubes, but it is conducive to rapid photographic work, the exposures for the thicker parts of the body being less than thirty seconds. To regulate the vacuum in the tube, Villard has devised an "osmo-regulator." This is based upon the fact that red-hot platinum is permeable to hydrogen. The regulator consists of a side tube attached to the X-ray tube. Into the outer end of this tube a tubular platinum wire is fused, the outer end of which is closed. When the vacuum becomes too high, it is only necessary to heat this platinum tube in a gas or alcohol flame, when hydrogen will pass in gradually. Heating for a fraction of a minute is all that is required, and the reduction takes place so regularly that it is easily controlled. A modification of this regulator consists in replacing the platinum tube by one of palladium, but the penetration of the latter by hydrogen is almost too rapid. Another difficulty due to the heating of the target has also been remedied by providing a water-cooled target. The platinum disc is fused into the end of a glass tube filled with water, which takes up the heat. This arrangement is very satisfactory, but it is difficult to construct. The great convenience which followed the use of induction coils on commercial voltages led to various efforts to adapt the coils to alternating-current circuits. For this purpose motor-generators, synchronizing interrupters, motor-driven rectifiers, aluminum-cell rectifiers and modified Wehnelt interrupters, which transmit only one phase of the current, are in use. The best form of interrupter is one running in synchronism, which may be adjusted so as to ensure that the rupture of the circuit shall coincide with the tops of the current waves. Recently, transformers have been constructed to take the place of the coil which give 100,000 volts. This is satisfactory for some purposes, but much work requires a voltage in excess of this. When using transformers there are two interesting methods of dealing with the half-waves of current which are not wanted. In one the valve tube of Villard is used, a pair of these being placed in shunt with the tube circuit so as to provide an easy path for those impulses which are in the wrong direction. In the other method a transformer having two secondary windings is used. One of these is of few turns, and has its circuit closed through an aluminum cell; while the other, of many turns, is connected to the X-ray tube. When in action one set of half-waves finds an easy path through the aluminum cell, while the other meets with a high resistance there, and hence passes through the long winding and the X-ray-tube circuit.—*Abstracted from Electrical Engineering (London), January* 31.

Radium and Geology.

The suggestion made by J. Joly, that the amount of radium contained in sea salt can not be explained by denudation of the earth's surface by water, and therefore it must come from some other source, which possibly is the sun, is not accepted by W. J. Sollas. The latter believes that Strutt's analysis of granite affords strong support to the view that the radium it contains is of terrestrial origin. The concentration of this constituent in the biotite might conceivably be due to the absorption of percolating water containing radium in solution, but not in the zircon, a mineral which is as impermeable as quartz. The heavy portion of the Cornish granite analyzed by Strutt—which was insoluble in hydrochloric acid—consisted of silica hydrate and zircon, and if the latter mineral was present to the extent of 0.16 per cent only, it must have contained but little less radium than that found in crystals of zircon from North Carolina. In the consolidation of granite the zircon crystallizes out, then the biotite and the other components, but the concentration of radium diminishes in a similar order, a correspondence that can hardly be the effect of chance. It is possible that the richness of granite in radium is due to the removal of this constituent in solution from the general mass of magma and its concentration in certain portions. If this be true of granite may it not be true of basalt and other basic rocks? All the igneous rocks to which we have access are various superficial parts of the earth's crust, and it is unsafe to reason from them to the deeper underlying regions. There may be other causes, apart from solution, by which electrically charged atoms like those of disintegrating radium have found their way up from below to enrich the uppermost layers of our planet. In any case, the assumption that radium is uniformly distributed through a crust forty-seven miles in thickness seems to require support from independent evidence, and until that is forthcoming it is equally open to us to assume a thick crust, 800 miles, consisting of silicates with radium distributed through it according to some unknown law, with a rapid increase toward the zone affected by highly heated waters.—*Abstracted from Nature (London), January* 31.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

Persistency as a Central Station Asset.

"Importunity Creates Opportunity."

You can make a piece of iron red hot if you hit it hard enough, and regularly enough, and long enough; but it makes no difference how hard you hit it, or how long you keep it up—unless you hit it regularly it will cool.

Let us talk about something nearer home by substituting central station advertising in place of iron. Central station advertising, in order to reach its highest efficiency, must be regular. Clock-like regularity, we were about to say, and as that is just about the right term, consider it said.

We've got to direct all our blandishments—in the way of advertising to the public—to "human nature." The public has the money, and human nature is stealthily whispering to it to hang on to it.

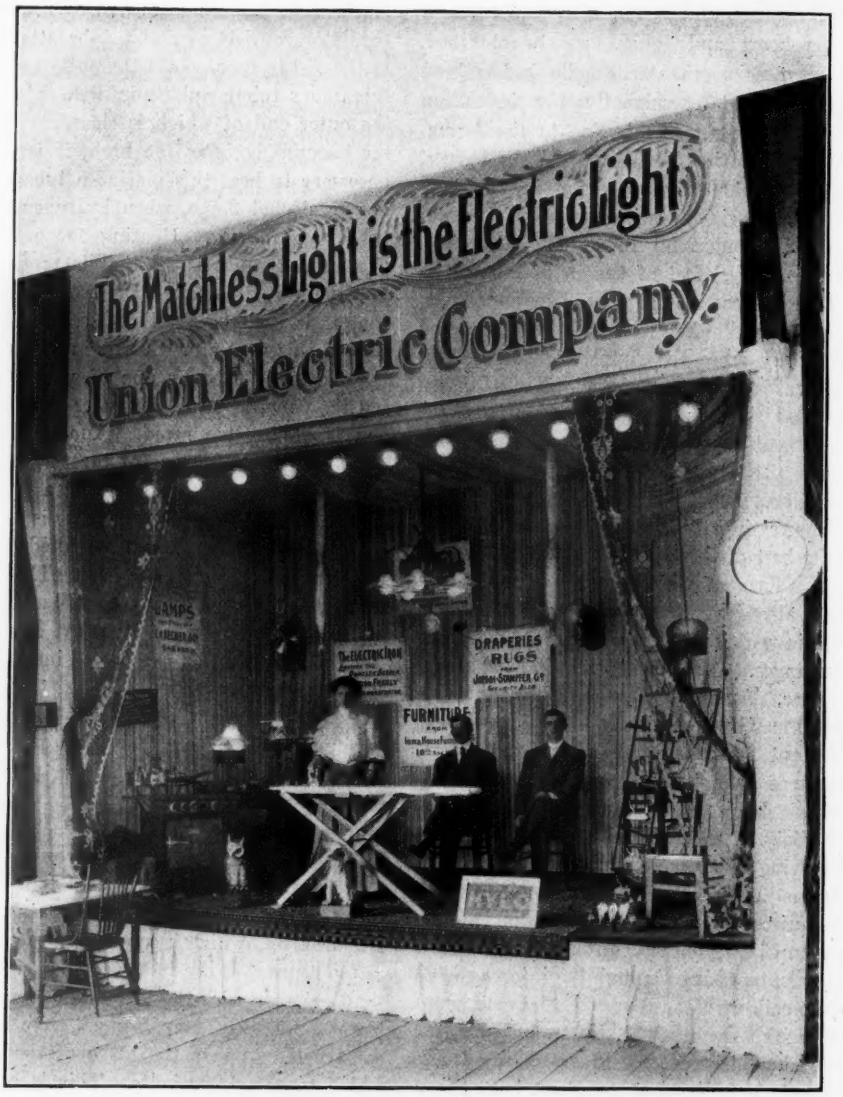
Human nature is capricious. You may put into its head to-day that it can not live happily without electricity. To-morrow, when you are out of sound and hearing, it reconsiders. If it doesn't take the trouble to reconsider, it forgets—and maybe that's worse.

An occasional spasmodic splurge, in big, red and boisterous advertising, may precipitate a more or less blinding flash when it happens and while the roar is on, but as it recedes it takes with it the memory of its presence from your public's mind. And it leaves the silence thicker than before, by contrast.

Your public is troubled with a short memory. It behooves the central station to contrive to keep its advertising in the centre of the stage, with the spot light on it, so as not to give the public a chance to forget it for ever so short an interval.

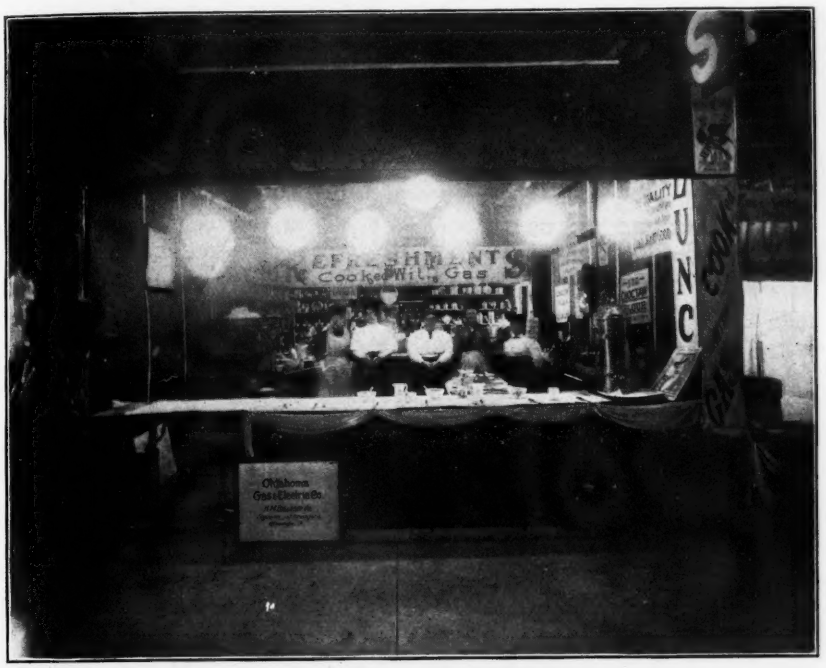
There was a famous oil once—named after one of the masculine saints, with flowing whiskers—which, by dint of persistent advertising, could be found in the cupboard of almost every household in the country. It cured rheumatism and other kindred human pleasantries, it was claimed. To-day it doesn't cure such ailments because it has gone the way of the traditional bone which old Mother Hubbard's pet canine tried to locate. Why is it thus? Isn't Saint Somebody or other's oil just as good oil to-day as it ever was in its palmiest days? Doubtless. Then why isn't it just as popular to-day as it was twenty years ago? Simply and purely and logically because when its proprietors, in a weak moment, felt that they had succeeded in advertising it into almost every home in the land, they unwisely conceived the notion that they should discontinue their advertising, save the money, and still continue to reap the rich reward of their former publicity. And the ungrateful public proceeded to forget it.

The price of successful advertising lies largely in never letting up. There are several "largelies" in this advertising business. First: Successful advertising lies largely in having a product worth advertising. Second: Your advertising depends largely on the amount of clearness, force, logic, argument and human interest you put into it. Third: It likewise depends largely on how regularly and how long it is followed out. The real importance of these "largelies" does not depend on the order in which they are here named. Per-



The Union Electric Company, of Dubuque, Iowa, is a firm believer in the value of demonstrating electricity to the public in every possible way. This picture represents the company's booth at the electrical show recently held in Dubuque

haps regularity in advertising comes first. It is hard to say, for the reason that no one of these factors can do its work without the auxiliary aid of a combination of all the others. All theories, and every experience, go to prove that the great public soon forgets, if it is not reminded regularly and with very short intervals between.



These two illustrations give a good idea of the splendid showing made by the Oklahoma Gas and Electric Company in its exhibit at a recent show held in that city.

The central stations have the product; there's no gainsaying that. The people want electricity. The people will have it—in time. Just how soon or at how remote a date they shall have it depends upon your advertising—depends on the regularity and persistency of that advertising.

In a serial service of mail advertising, each piece should tread upon the heels of its preceding piece so regularly as to allow no recipient an opportunity to forget between times. If that happens, the context of the service is greatly weakened, and the entire series loses important sequence and persuasiveness.

If it takes ten strokes of a hammer to drive a nail in, and you stop with six blows, the nail will not be driven in, and you will not have accomplished your purpose. If you stop at the ninth blow, you will be just about as badly off. You have some folks on your list who require only six blows to convince them. Others require eight blows. Others, perhaps, nine blows. As you have no way of divining which is which, it behooves you to strike your full quota of blows, else you will miss much that is awaiting you.

The situation is something like this: There's a heavy, thick, dense, solid wall of indifference which separates the great public from you. In order to reach this great public, you have got to break down or tunnel through this wall. The wall is stout, for it has been in the building for many years.

Can you conceive of one piece of advertising—sent out without regularity, or now and then, or whenever you happen to think of it—that would be sufficient to wear down this time-seasoned wall?

One such piece of advertising, of course, strikes its blow, but it makes but a momentary dent. Then long before you get ready to strike the next blow, the stones settle down once more into place and close up the dent. Then you must start all over at the beginning again. It doesn't pay for you to lose the work of the preceding blows—your iron cools off between blows.

Now this wall is not so formidable or insurmountable as in most businesses. Folks are anxious. They are climbing up their side of the wall and slyly peering over the top to catch a sight of what this electricity really is. It is your duty to lower the wall and allow the people to jump over. One blow—one piece of advertising—won't do it. But if you set yourself assiduously to the work and hammer and pound persistently and regularly with letters, mailing cards, novelty folders, attractive booklets, monthly bulletins, space in the daily newspapers, etc., etc., it will be but a matter of time before you will have the satisfaction of seeing the wall totter and fall, and the people who have been separated from you so long, swarm over to your side and grasp the advantages which you have been beckoning them to.

Regularity of purpose is the thing. Persistency to the extent that you shall keep your product in the minds of your people all the time is the scheme. Make enough noise, often enough, to keep folks from going to sleep. So long as you can keep them awake and their ears pointed in the

right direction, you can figure on them. So much for printed advertising.

Then come the solicitors. Trudging along in the wake of such missionary advertising, your solicitors have a ready-blazed trail to follow—the way is prepared—conditions are shaped for their welcome reception. Your best arguments have been presented with more care, detail and force than any solicitor could even hope to have time or a welcome for. The upshot is that practically all your solicitor has to do is to happen along, and at the psychological moment "button the business up."

Solicitors should, of course, know their entire proposition by heart, and be prepared to advance every last argument which your printed advertising has exploited. Let the manager see to it that a copy of every piece of advertising be placed in the hands of his solicitors, that they may read it over, study it, familiarize themselves with it, and be ever ready to work in conjunction with it, so that there may at all times be a harmonious effort between the solicitor and the advertising in a sort of reenforced siege against the public bulwarks.

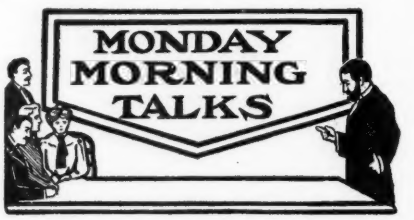
It is not written that the solicitor who knows his proposition thoroughly, and who repeats the very arguments which have been made familiar to the business man by advertising, is going to be regarded with disrespect by that business man. Nearly every successful business man has reached success largely by his own persistency, and such men admire the same quality in others. Once in a while you will find a business man with this emotion so strongly implanted in his breast that it will impress him favorably when he fires a solicitor out of the door to see him come right back through the window, but it isn't a condition that can be depended upon always.

There are two kinds of persistency. One is the wrong kind. The other is the right kind. And the solicitor who is evenly balanced knows which one to select. The fundamental thing is for the solicitor to know his proposition thoroughly and to keep in close touch with the current advertising sent out by his company.

Then, too, the manager has his place to fill in this business-getting persistency scheme.

He is looked up to more or less as an example by his men.

Let the modern manager view each morning as the beginning of what he has made up his mind to make the one particularly bright day in his company's history. His enthusiasm is infectious among his solicitors. It is his duty to keep them screwed up to high pitch, and full of joy in their work. His is the province of familiarizing his solicitors with the advertising that is being done. He should see that they study it, learn it by heart (learn it by rote, if need be), and fully fit themselves to answer any possible question regarding this advertising a prospect may chance to bring up. Brand new, fresh arguments and reasons are constantly coming to life, and the manager should see to it that each and every solicitor keeps abreast of all the new and good.



Under this general heading we shall present to our readers a series of bright, stimulating talks to solicitors, which, we believe, will prove valuable to managers of new-business departments in suggesting points which they can profitably bring out in their occasional meetings with the company's representatives.

We shall gratefully accept contributions and suggestions from any of our readers.

I want to talk to you fellows on the firing line this week about half-hearted salesmanship.

Because, after a salesman has been up against a few pretty stiff propositions and arguments against his line, unless he has real backbone in his make-up, unless he can show the right kind of fight necessary to land his man, he is not going to last in this selling game.

And not only a keen knowledge of the value of electricity for the purpose you are trying to sell it, but a thorough belief in its merits along that line are necessary to rightly convince your prospective customer.

That's where so many salesmen fall down and lose out. They can not enthuse their prospect to the point of signing up because they haven't the necessary steam for a good closing talk. In other words, they haven't first sold *themselves*. Deep down in their souls they have a lingering doubt as to just whether their product is truly all they claim for it—a suspicion the man the solicitor is talking with unconsciously feels. And until you get this from your mind and are absolutely sure this man should and could use electricity to advantage—until you can feel its good qualities for his purpose and impart them to your man—then and not till then can you expect success in selling.

Go some place where you can be alone and enumerate to yourself the talking points of the line you are selling. Fix in your mind all its good qualities. Be enthusiastic. Don't feel apologetic or that you are trying to sell a gold brick. You aren't. You are showing him something he needs in his business and will probably buy if you can show him in the right way. Then, when you have sold yourself and believe these truths in your heart, tackle a difficult, hard-headed customer. When you approach him in your new way, notice how different his response—notice the impression you are making through his hard shell. He is imbibing some of the enthusiasm you are letting go off and begins to see your arguments in your light.

No salesman makes a success by half-hearted efforts—no big contracts or permanent successes in selling come unless you enter into your work in a genuine, whole-hearted sort of way. Have you an apologetic feeling in your heart for electricity or your company's service? Have you any doubts or fears that leave an impression with your customers? Wipe these away—believe in yourself and your company and be determined to roll up a volume of business that will show this earnestness.

It will be our endeavor, from week to week, to present in this department brief notices of activities among the central stations, as gathered from men who are in the field and, consequently, in close touch with the progress of the new-business idea and its acceptance by central station managers. Contributions to this department are solicited, and will be received with much appreciation by the editor.

If you are doing something a little better than or different from the other fellows, and think it would make interesting reading to ELECTRICAL REVIEW readers, send in your schemes and plans. They will be gladly received.

Address all communications to Charles A. Parker, care of the ELECTRICAL REVIEW.

Few people living in the eastern or central states ever think of Oklahoma except as part of the wild and woolly, and it would undoubtedly be a surprise to a great many of us could we pay a visit to this newly acquired and constantly more important section of our great country. Here is to be found the spirit of the pioneer and the enterprising grit which have had so great a part in the building up of our nation.

Thoroughly in keeping with the pioneer spirit is the splendid work being done by the Oklahoma Gas and Electric Company, of Oklahoma City, Okla. F. H. Teddman, the manager of this company, believes in the education of the public in every pos-

sible, reasonable manner. He is conducting for his company a very strong and efficient direct-by-mail campaign and is reenforcing this educational work by demonstrations of every possible kind, so that the public whose interest is aroused by the advertising matter has something technical to feed upon when its appetite is whetted by the printed announcements of the company. We are pleased to show some excellent photographs of the gas and electrical exhibit made by this company at the electrical convention held last December. At this exhibit demonstrators were engaged by the company to exhibit various devices, which consisted of the General Electric Company's flat-irons, full equipment of electrical kitchen utensils, luminous radiators, electric pump outfits, sewing-machine motors, three-phase and single larger motors, and all the latest appliances known to the trade. Among the latter were the Vulcan Manufacturing Company's soldering irons, electric drills and grinding machines. Another interesting and exceedingly valuable feature of the exhibit was an electric meter in operation, with an attendant in charge, whose duty it was to explain to all interested how to read their meters. Copies of an exceedingly attractive Christmas bulletin, which constituted one of the pieces used in the company's direct-by-mail campaign, were distributed to the public in the main aisle of the exhibition.

Some of the central station men in small cities, who think they are absolutely beyond the pale of new-business-getting because they are working under the disadvantages of a limited field, ought to take heart when they are made acquainted with the circumstances surrounding the Consumers' Company, of Cœur d'Alene, Ida. George Harding, of this company, is thoroughly wide-awake, and is out after the business just as aggressively and as successfully, for that matter, as if he had a population of a quarter of a million to work on, instead of only six or seven hundred souls. A1 service and clever, forceful direct-by-mail advertising are being used successfully in fighting acetylene and gas competition. An evidence of the down-to-dateness of this company, which many larger companies could well afford to model after, is the fact that it offers to pay one-third of the cost of wiring residences. The company reports three hundred customers.

The Commonwealth Electric Company, of Jackson, Mich., enjoys the proud distinction of having perhaps the finest display room and demonstration hall of any electric company outside of the very largest cities; in fact, in many ways it's the peer of display rooms, so far as the knowledge of the writer goes. Some most excellent photographs of this display room are in the course of preparation and will be given to the ELECTRICAL REVIEW readers within the next few weeks.

A. T. Lloyd, superintendent of the electrical department of the Shreveport Gas, Electric Light and Power Company, of Shreveport, La., has recently worked out a very creditable scheme for securing the wiring of old and new residences in his city. This was by stimulating the interest of real estate men and owners of rented property by sending them the following letter, which has resulted in about thirty houses being wired within a short time.

McCLOUD & HESTER,
City.

Gentlemen:

As men of experience in renting houses in Shreveport, I think you will admit readily that whatever tends to secure a better class of tenants to rent your houses and to remain in them is a good thing.

But in the hurry and bustle of business have you ever stopped to consider how you could bring about this desired result easily with a small investment?

You can do it by wiring your houses for electric lights.

Twelve dollars will wire five or six lights in almost any house you own. We will wire all rented houses at absolute cost during the month of August in order to increase our business.

Since our reduced rates took effect, oil lamps are little, if any, cheaper in Shreveport than electric lights.

Below is a list of property owners who recently have wired some or all of their houses.

Dennis Ricou.
W. W. Jones.
Mrs. Henrietta Bertrand.
J. D. Wilkinson.
Mrs. F. S. Furman.
Dr. Smith.

Let me figure with you during the month of August.

Yours very truly,
A. T. LLOYD, *Elec. Supt.*

Such plans worked in connection with systematic campaigns of mail advertising, etc., etc., can not fail to win out.

SUCCESSFUL SELLING, NEW OR OLD.

BY C. A. HOWE.

Too many of us confuse ambition with a desire to have things handed to us.

Business rarely comes unsought and unfought for.

The foundation of business-getting or successful selling is knowledge, the superstructure good hard work.

Don't entertain any thought of success without these attributes; with them, well mixed with self assurance, you will succeed in any line.

Study your line—study human nature. The salesman has to know and do a whole lot to make the optimist and pessimist happy, and he encounters them both in selling.

You will observe I use the phrase "successful selling." I wonder how many salesmen stop to realize that to "unload" a large quantity of goods on a customer, either at a large or small profit to the firm they represent, may be far from "successful selling?"

We are not altogether in the age of now; there is a future to be considered.

It is not what your customer buys that is most vital to you or your house; it is what he sells.

Study well your buyer. Study his wants—his outputting opportunities. Then endeavor to sell him what he can resell or use to advantage.

Approach the buyer, not alone laden with knowledge of your own line, but with all the knowledge you can obtain on lines affiliated with his. The intelligent buyer would rather greet a knowledge bringer than a pocket full of cigars, invitations to drink, or other offered entertainment, that seeming has design back of it. Acquaintance may in time warrant entertainment, but let it well ripen first.

Sow seeds of knowledge and not dissipation and you will reap a bigger harvest of "successful selling."

Don't be content to sell the buyer. Encourage his selling organization to push your line by educating them on all the points that give it its value.

A saleman's value is his ability to produce. His income is based upon it. An increase comes only with greater production and greater production comes only with greater knowledge and its untiring application.

Years ago we had the "drummer." Then came the "traveling man." More recently he assumed the dignity of the "salesman," and at a recent banquet in Chicago the "salesman" of one of the largest electric supply houses in the country was heralded as the "ambassador."

Misinterpreted symptoms of genius have been the occasion of many young men losing their positions. Genius and success often go hand in hand and they are invariably builded on knowledge and work.

Just a few words more. Encourage your firm to publicity. Don't let them think the only channel for letting the trade-world know they are on earth is through the medium of the "ambassador."

Tell them to advertise before and after each sunrise, and supplement the efforts of the boys on the road.

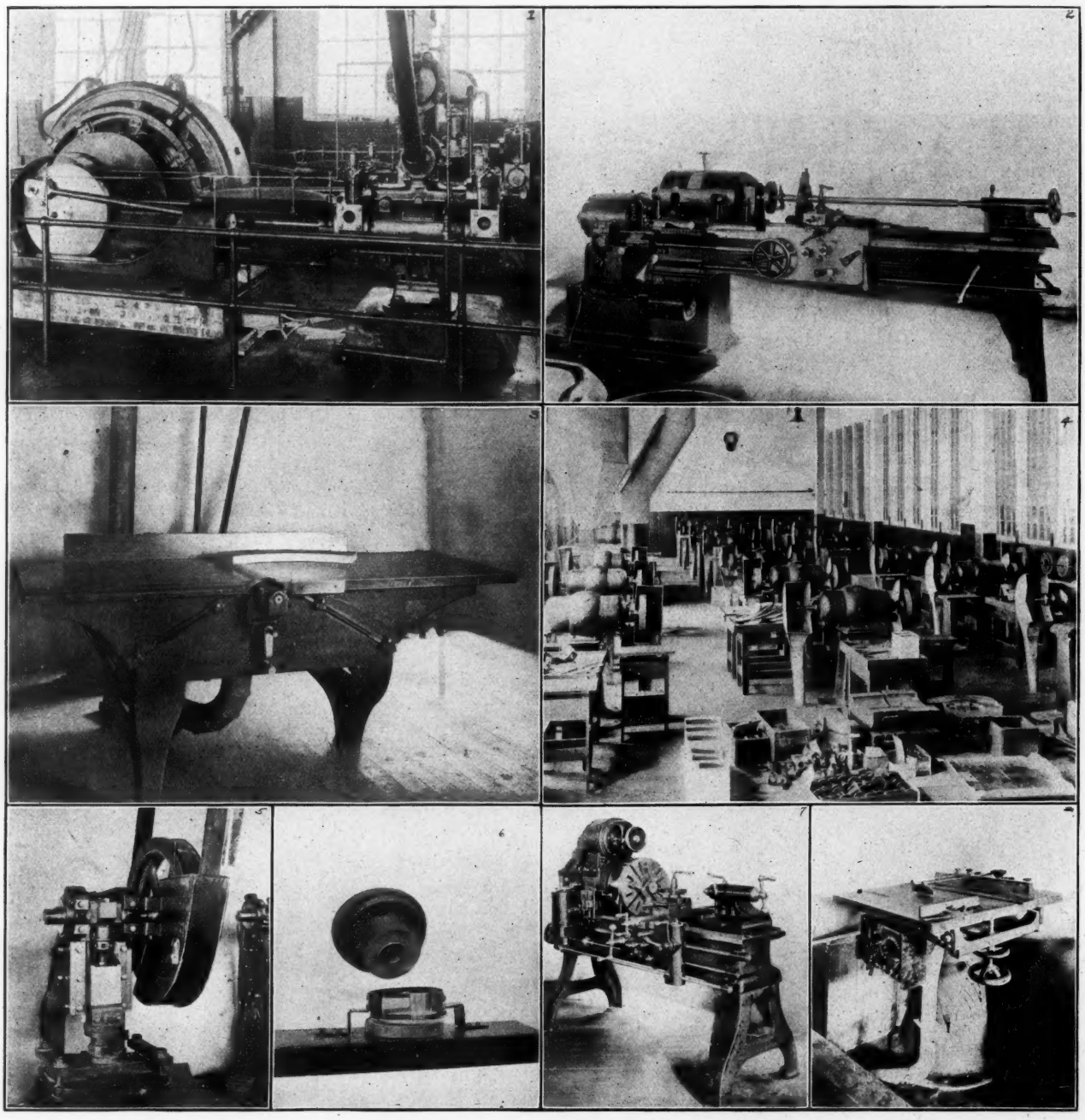
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Safety of Electrical Machinery.

The exhibit of the General Electric Company at the First International Exposition of Safety Devices, held under the auspices of the American Institute of Social Service at the Museum of Natural History, New York city, January 29 to February 12, contained many interesting examples of the altruistic tendencies of modern manufacturing. Not the least noteworthy feature is the extent to which electricity has aided in the improvement of operating conditions.

Some of the marked advantages of the electric drive are shown in the accompanying illustrations. Perhaps the chief gain in safety of the electric drive lies in the



EXAMPLES OF SAFETY DEVICES ADAPTED TO MACHINE TOOLS. 1.—MOTOR-DRIVEN AIR COMPRESSOR. 2.—MOTOR-DRIVEN LATHE. 3.—SURFACE PLANER. 4.—DUST COLLECTORS FOR EMERY GRINDERS. 5 AND 6.—SAFETY DEVICE ON MICA PUNCH PRESS. 7.—MOTOR-DRIVEN LATHE. 8.—SAW GUARD.

elimination of all belts. The electrically operated machine is driven by a train of gears which are completely enclosed. It is thus impossible for the hands or clothing of the operator to come into accidental contact with the driving mechanism. With the elimination of belts comes also unrestricted head room with consequent improvement in light and ventilation.

In addition to the inherent advantages of the electric motor drive, many special protective devices for machines were exhibited. These included railings about machinery, saw guards, exhaust dust collecting systems, etc. Some of these protective features are shown in the accompanying illustrations.

Fig. 1 shows a motor-driven air-compressor at the Schenectady works of the General Electric Company enclosed by a pipe railing so that accidental contact is rendered impossible. Fig. 2 illustrates a Lodge & Shipley lathe driven by a General Electric three-horse-power motor. The complete protection of gearing, and the general compactness of the drive are to be noted. Fig. 7 emphasizes the same points, showing a Reed lathe driven by a one-horse-power motor mounted above the head-stock. Figs. 5 and 6 give a good idea of the device for protecting the fingers of the operators of a mica punch press. This press is provided with a transparent ring guard, which prevents catching the fingers under the punch, at the same time permitting inspection of the work.

One of the most frequent causes of accident in the wood-working shop is the surface planer. The device illustrated in Fig. 3 removes the chance of accidental contact of the operator's fingers with the revolving cutter. It consists of thin steel bands completely covering the cutter. As the work is fed toward the cutters a certain number of the bands, depending on the width of the piece, are pushed below the surface of the table. The width of the cutter not actually removing stock, however, remains covered by the protecting steel bands so that the fingers guiding the piece can not come in contact with the cutter blades. The guarding bands being worked against a spring, return to position as they are uncovered.

The saw guard illustrated in Fig. 8 is self-explanatory, as well as the dust collecting system illustrated in Fig. 4. The last-mentioned figure also presents an interesting feature of the motor drive. The grinding wheels are mounted directly on the extended shaft of the motor, thus eliminating both belts and gears and making the grinding unit as simple as possible.

The "Monarch" Engine Stop.

One of the most interesting exhibits at the first international exposition of safety devices, held recently in New York, under the auspices of the American Institute of Social Service, at the American Museum of Natural History, was the "Monarch" engine stop, manufactured by the Consolidated Engine Stop Company, New York city.

The "Monarch" engine stop is a device which can be attached to the throttle valve of any engine for automatically shutting down that engine in case of overspeeding or racing, which usually causes the flywheel to burst.

It also has the additional feature of giving remote control of the engine—that is, by placing any number of switches at any distance from the engine room, the engine can be shut down in a very short time, should an employé get his hands or clothing caught in the machinery, by simply pushing a switch.

As the apparatus is operated by means of an electric circuit, either battery or direct-current, there has been adopted a very simple multiple-loop system for the circuit-closers, the speed limit being considered a circuit-closer. With the improved test board, this circuit, as well as the circuit passing through the various apparatus, can be tested, and should a wire become broken the test would show it. However, the switches would operate the entire apparatus until at least three wires were broken.

For gas engines the company uses its regular speed limit in connection with a small double-pole knife switch which opens the ignition circuit the instant the danger limit has been reached.

EXHIBIT OF THE CONSOLIDATED ENGINE STOP COMPANY AT THE EXPOSITION OF SAFETY DEVICES, NEW YORK CITY, JANUARY 29—FEBRUARY 12.

Allis-Chalmers Air-Brakes for Foreign Shipment.

A carload of air-brakes recently left the West Allis works of the Allis-Chalmers Company, eastward bound for foreign shipment. The air-brake department has up to the present time been actively engaged in supplying the regular demands of domestic trade. The present shipment to a foreign country, therefore, marks a step forward for this additional line of production of the company.

Air-brakes are being used to a greater extent every year. The impetus of the past few years given to the building and operation of interurban and electric railways has greatly increased the demand in this country and abroad for brakes of this description.

Auckland, New Zealand, Power Scheme.

Some great electrical engineering projects have been submitted to the New Zealand government by its engineer-in-chief, in the course of a report on the utilization of New Zealand's abundant water power. One of the most notable schemes aims at tapping the Huka Falls, and supplying the Auckland district with 76,000 horse-power, the estimated cost of the necessary plant and works being $8,000,000.

Current Electrical News

DOMESTIC AND EXPORT.

NEBRASKA TELEPHONE COMPANY—A special meeting of the stockholders of the Nebraska Telephone Company has been called by the board of directors to be held at the office of the company, Omaha, Neb., Saturday, March 16, 1907, to act upon a proposed amendment to the articles of incorporation of the company, increasing the capital stock, heretofore fixed at $5,000,000, to $10,000,000, the increase of stock to remain in the treasury to be disposed of by order of the board of directors.

COLORADO POWER COMPANY INCORPORATED—Articles of incorporation have been filed with the secretary of state of Colorado for the Commonwealth Power and Electric Company, with headquarters at Georgetown. Its capitalization is $2,000,000, and for the first year the directors will be Henry Kneisel, Frank A. Maxwell, J. W. Aylor, M. Sidney, Henry J. Crist, Clarence A. Lawson and C. D. Runkle. The company will furnish power in Clear Creek, Gilpin, Grand, Eagle, Lake, Routt and Summit counties.

CUMBERLAND TELEPHONE—At the annual meeting of the stockholders of the Cumberland Telephone and Telegraph Company held at Hopkinsville, Ky., the retiring board of directors was reelected, with the exception of N. Baxter, Jr., of Nashville, Tenn., who was succeeded by John W. Barr, president of the Fidelity Trust Company, of Louisville, Ky. A vacancy due to the death of George R. Knox, was filled by the election of W. S. Bransford, of Nashville, Tenn. The stockholders authorized an increase in the capital stock of from $20,000,000 to $30,000,000 for the purpose of enlarging the working capital and acquiring new properties.

GUANAJUATO POWER AND ELECTRIC COMPANY—A special meeting of the stockholders of the Guanajuato Power and Electric Company will be held at Colorado Springs, Col., on March 9 at 12 o'clock, noon, to act on an increase in the common stock from $3,000,000 to $3,500,000 and the proposition to guarantee $1,000,000 of the first mortgage bonds of the Michoacan Power Company in consideration of $1,000,000 of the full-paid capital stock of the Michoacan Power Company. Books close March 2 and will remain closed until the day after the final adjournment of said meeting. The annual meeting of the company has been called for March 26 at 12 o'clock, noon.

TWO PROPOSED ALABAMA DEVELOPMENTS—The water powers on the Locust fork of the Warrior river near Birmingham, Ala., have been bought, and options secured on about twelve miles of the Warrior river, with the view of developing and furnishing the city of Birmingham 25,000 electrical horse-power, and supplying the city with an abundance of water by a gravity canal, for all industrial and domestic purposes. Two surveys have already been made which prove both of these developments to be practical and desirable. Parties interested in these developments can secure further information from E. J. McCrossin, Woodward Building, Birmingham, Ala., or John L. Ray, president of the Albertville Realty Company, Albertville, Ala.

WORK ON GREAT WESTERN POWER COMPANY'S PLANT STARTED—The Great Western Power Company has completed preliminary operations at Big Bend, Cal., and active development work has begun. At present 300 men are at work, and the force is to be increased to 600. The old Big Bend tunnel is to be enlarged and lined with solid concrete masonry. It will have an inside measurement of 235 square feet. A new tunnel, 3,500 feet long, will be driven from the end of the old tunnel up the north fork of the river. From the outlet of this tunnel the water will be carried to the power-house in pipes. Present plans call for the development of 50,000 horse-power, and the total capacity of the plant will be 100,000 horse-power. The total fall will be 525 feet. The company expects to expend between $5,500,000 and $6,000,000.

EXTENSIVE CANADIAN ENTERPRISE—It is announced that through the organization and incorporation of the Dominion Power and Transportation Company, of Hamilton, Ontario, a very important electrical enterprise has been launched. This company has become the parent company of the Hamilton Cataract Power, Light and Traction, and all its allied interests, as well as of the Brantford & Hamilton Electric Railway Company, and the Western Counties Electric Company. Its lines of railway and power transmission will extend from the Niagara to the Detroit river, and will take in Toronto and all the large cities and towns in Ontario. The organization of the new company came about through the increase of the business of the Cataract company, the extensions of its plants and the acquisition of other properties making additional capital and greater financial capability necessary. The Dominion Power and Transmission Company will be the chief and holding company. The Hamilton Cataract Power, Light and Traction Company will continue to be an operating company, but its stock will be mainly held by the Dominion Power and Transmission Company, as already the exchange has taken place of a controlling amount of the former for similar stock of the latter.

POWER PLANT PROJECTED—It is said that a large water power plant will be developed at the falls of the Cumberland river in Kentucky. The expenditure of not less than $3,500,000 is promised to complete the project. These falls are twenty-five miles down the river from Williamsburg, Ky., which is about seventy-five miles from Knoxville, on the Louisville & Nashville Railroad. The project calls for the building of a dam in the river just above the falls. This dam will back the water up to Williamsburg and up tributary streams, making a large lake. Considerable property that will be overflowed has been bought. The valley averages from half a mile to over a mile in width all the way, except in one or two gorges. In order to develop this power, a syndicate has been formed in New York by William F. Cox, of New York; S. S. Wetmore, of Philadelphia; S. L. Merchant, of Boston, and associates. They have employed Arthur Hiesler, of New York, a hydraulic engineer, to make the plans for the work. It is the purpose of the syndicate to erect a large reduction works. The initial capacity of the plant will be not less than 20,000 horse-power, which will be used by the works. It is expected that the plant will be in operation within eighteen months.

NEW POWER COMPANY FOR NORTH CAROLINA—Application has been made to the North Carolina general assembly for a charter for the Tide Water Power Company, organized to supply electric light and power to Wilmington, N. C. The new company will be a subsidiary of the Rockingham Power Company, and is organized primarily for the transmission of current from the development near Rockingham to Wilmington. A tentative contract has been entered into with the Rockingham company for the purchase, for a term of forty years, of 10,000 horse-power. The incorporators are M. F. H. Gouveneur, Maj. E. W. VanC. Lucas, T. W. Davis, M. J. Heyer and Hugh MacRae, all of Wilmington. The capital stock is to be $750,000 with the right to increase to any amount that is desired. The Rockingham Power Company is a development company having $4,800,000 subscribed capital, and $8,000,000 authorized capital. The directors of the company are M. F. H. Gouveneur, of Wilmington; E. A. Smith and F. Z. Mitchell, of New York; R. L. Warner and S. N. Bond, of Boston, and H. A. Pressey, of Washington. The company is expending large sums in construction work at Bluitt Falls and in the erection of a power-house there, from which electricity will be transmitted to factories and towns within a radius of ninety miles. The dam under construction is 1,650 feet long on the crest and fifty feet high.

POWER COMPANY REORGANIZED—The Nevada-California Power Company, capitalized at $5,000,000, has been organized to

take over the properties, rights and assets of the Nevada Power, Mining and Milling Company, of Denver, Col. The company is also permitted to issue $3,000,000 bonds. The $5,000,000 capital stock represents an increase of $4,000,000 over that of the old company. This reorganization was effected to permit of many extensions and improvements to the system, among which are the following: The extension of the company's power lines in the Bullfrog district and the installation of electric power and light systems in the entire Bullfrog district. The construction of an entirely new transmission line from Bishop Creek, Cal., to Silver Peak, Miller and Tonopah to connect at the latter place with the present transmission line and giving duplicate service at all points now reached by the company's lines. The construction of two additional generating plants at Bishop Creek, which will more than double the company's generating capacity. The construction of two reservoirs on Bishop Creek, the largest of which will have a capacity of 300,000,000 cubic feet, for the purpose of impounding the water supply so as to add to the low flow at certain times of the year. The construction of new transformer stations at Tonopah, Miller, Silver Peak, Goldfield and Rhyolite. It is estimated that the proposed improvements will cost approximately $1,500,000, and contracts for this amount have been awarded. The company hopes to complete the work during the present year. It will then have over 300 miles of transmission line, in addition to 200 miles of telephone line. The company has entered into long-time contracts with the principal mining companies of Tonopah, Silver Peak, Goldfield and Bullfrog, including the Desert Mill and Power Company at Miller, the Montana-Tonopah Mining Company, the Tonopah Mining Company, the local railroad company, the Tonopah Water Company and many other companies.

NEW INCORPORATIONS.

HARRISBURG, PA.—Twelfth & Thirteenth Street Railway Company of Reading. $30,000.

SPRINGFIELD, ILL.—Mississippi Valley Telephone Company, Carthage. Capital increased from $50,000 to $100,000.

PORTLAND, ME.—Cove Hydro-Electric Company, Portland. $2,000,000. President, J. E. Manter; treasurer, C. E. Eaton, Portland.

MILWAUKEE, WIS.—La Crosse Gas and Electric Company, La Crosse. An amendment increasing its capital from $600,000 to $900,000.

MADISON, WIS.—The Oshkosh Electric Company, Oshkosh. $10,000. Incorporators: William R. Hill, Frank S. Felt and Frank B. Griffin.

ALBANY, N. Y.—Universal Electric Security Company. $4,000. Directors: H. B. Hackley, B. H. Mills, Albany; George Moosman, Rensselaer.

ALBANY, N. Y.—Cheektowaga Railway Company, Cheektowaga. $75,000. Incorporators: W. H. Finch, C. E. Williams, M. B. Spencer, Buffalo, N. Y.

LOS ANGELES, CAL.—National Electric Company, of Los Angeles. $25,000. Directors: H. E. and L. B. Yockey and E. Tucker, all of Los Angeles.

SPRINGFIELD, ILL.—Galatia Independent Telephone Company, Galatia. $1,065. Incorporators: S. D. Lockwood, C. E. Robinson and Noah Reynolds.

LYONS, IND.—Lyons Co-Operative Telephone Company, Lyons. $10,000. Directors: John Davidson, G. W. Carpenter, W. D. Boyd and George Davidson.

SPRINGFIELD, ILL.—Chicago & Western Telephone Company, Chicago. $100,000. Incorporators: Conrad H. Poppenhusen, Joseph L. McNab and W. G. Hamilton.

DENVER, COL.—The Manitou & Interurban Railway Company. $600,000. Incorporators: C. W. Dolph, J. K. Vanatta, E. A. Sawyer, William Garstin, S. D. McCracken.

CALLICOON, N. Y.—Callicoon Electric Light, Heat and Power Company, Callicoon. $25,000. Directors: Martin Herman, Peter Herman, F. S. Anderson, Callicoon.

ST. LOUIS, MO.—Central Interurban Traction Company. $50,000. Incorporators: Charles A. Gutke, Lee A. Hall, John A. Laird, Samuel J. Will and John C. Clark.

MERIDEN, CT.—The Quinnipiac Power Company. $8,000. President, Homer A. Curtiss, Meriden; secretary and treasurer, Clifford W. Leavenworth, Wallingford.

NEWARK, N. J.—The Torridoor Power, Light and Heating Company of America. $125,000. Incorporators: J. M. W. Kitchen, Frank R. Wickes, Harry H. Picking, East Orange.

PORTLAND, ME.—Idaho-Oregon Light and Power Company, Portland. To operate light, heat and power plants. $7,000,000. President, J. E. Manter; treasurer, C. E. Eaton, Portland.

LOS ANGELES, CAL.—The Taylor & Walker Electric Company, of Los Angeles. $5,000. Directors: William F. and Charles E. Taylor, Josephine L. and Jessie Taylor, all of Los Angeles.

CAMDEN, N. J.—Susquehanna Railway, Light and Power Company, Camden. Electric light company in all its branches. $100,000. Incorporators: W. M. Canby, F. McCown, J. J. Hope, Camden.

DES MOINES, IOWA—Capital City Railway and Telegraph Institute. $5,000. B. F. Williams, president; W. H. McCauley, vice-president; F. L. Meyer, secretary and I. H. Carothers, treasurer.

INDIANAPOLIS, IND.—The Darmstadt Telephone Company, Darmstadt. To maintain a telephone system, etc. $1,000. Incorporators: Frank Zeliak, J. Wesley Stark, John Wolf, Jerome Obert and Frank Karges.

CARBONDALE, PA.—Simpson Electric Light, Heat and Power Company. To operate a plant in Simpson, Fell township. $20,000. Incorporators: Joseph W. Wilce, Louis E. Berg, Daniel W. Lynch, Thomas Harner, Owen J. Timmons.

JAMESBURG, N. J.—Jamesburg Light and Water Company, Jamesburg. To operate water works, electric light plants, etc. $100,000. Incorporators: W. H. Brown, Newark; W. J. Lansley, Woodbridge; H. B. Clark, Plainfield.

MILWAUKEE, WIS.—The Wisconsin Electric Railway Company, Milwaukee. An amendment changing its name to the Southern Wisconsin Traction and Light Company. William F. Adams, president, and Walter D. Hickman, secretary.

AUSTIN, TEX.—Dallas Interurban Electric Railway of Dallas. $2,400,000. Purpose, to build and operate a railroad between the city of Dallas and other towns of the state. Incorporators: D. E. Waggoner, C. C. Slaughter, C. T. Alexander, R. C. Buckner, J. M. Carter, O. H. Lang, J. B. Nabors, S. A. Stemmons, D. Sonnentheil, I. J. Willintham and M. H. Wolfe, all of Dallas.

LANSING, MICH.—The Saginaw, Owosso & Lansing Railroad Company. $600,000. To build an electric railroad from Saginaw to Lansing, touching at Owosso and other intermediate towns. Incorporators: John L. King, Syracuse, N. Y.; Phil H. McMillan, Charles B. Warren, Charles W. Baird, Frank W. Eddy, Frank West, Thomas E. Reeder, George M. Black, J. A. Thick, William B. Cady, Detroit, and Frank B. Richardson, Cleveland.

INDIANAPOLIS, IND.—The Wawasee, Ligonier, Topeka & Lagrange Railway Company of Ligonier. $50,000. To construct an interurban line from Lagrange to Wawasee, through Kimmell, Cromwell, Topeka and Ligonier, to build parks along the line and to furnish light and power for commercial purposes in the towns through which the line passes. Directors: F. H. Green, F. E. Weir, F. K. Bothwell, J. U. Babcock, Sumner Dowell, I. J. Vaughn, A. J. Hostetter, B. B. Johnson and F. J. Dunten.

ALBANY, N. Y.—The Bowery Bay Railroad Company, of Long Island City; to operate a street surface railroad three miles long from Woodside to Astoria; $100,000; directors: Thomas Crimmins, of New York; A. S. Williams and William Richardson, of Long Island City. The Cheektowaga Railway Company, of Cheektowaga, Erie county; $75,000; to operate a street surface railroad five miles long from Cheektowaga to Buffalo; directors: W. H. Finch, C. E. Williams and H. H. Bennett, of Buffalo.

ELECTRIC LIGHTING.

FREMONT, NEB.—It is stated that work on the proposed municipal light plant will begin shortly, the $50,000 received from the sale of bonds being now in hand.

CANON CITY, COL.—The officials of the town of Rockvale have granted to the Arkansas Valley Electric Company, of Florence, a five-year contract for street lighting.

RED CLOUD, NEB.—The new electric light plant is finished and Red Cloud now has lights for the first time in twelve years. The old plant was destroyed by fire and owing to legal complications no plant could be installed until the present time.

GAYLORD, MICH.—The village of Vanderbilt has granted the Parks & Kelly Shingle Company a ten-year franchise to light the village with electricity and furnish current for private use. The company's plant was recently destroyed and it is now rebuilding.

SPARTA, MINN.—The Elba mine will commence immediately to put in an up-to-date electric light plant at the location near McKinley. Both the surface and the underground workings of the mine will be lighted. Light will also be furnished to various homes near the plant.

ROWLESBURG, W. VA.—Rowlesburg is to have a municipal lighting plant, and has decided to issue $12,000 worth of five per cent bonds, to run for 130 years, the proceeds to be used in the construction of the plant and the necessary wiring. The bonds will be sold subject to bids to be filed with the town recorder before February 11.

SILVER CITY, N. M.—A 1,000-horse-power electrical power transmission plant, supplying at least 500 horse-power by January 1, 1908, is the promise held out by eastern capitalists for the Cooney and Mogollon mining districts. The plant is to cost in the neighborhood of $200,000, and will be a great factor in the future development of these districts.

MEDINA, N. Y.—The board of trustees has entered into a contract with the A. L. Swett Electric Light and Power Company for street lighting for a period of five years from February 1. According to the contract, the most approved lamps will be used, and Medina will have an all-night, every-night service, and will pay therefor the sum of $70 a year for each lamp. Mr. Swett furnishes incandescent lighting free to the police station, the village hall and the engine house. He also furnishes lighting for the school buildings to an amount not to exceed $150 per year.

MONTPELIER, VT.—Announcement has been made public of the sale of the J. C. Viles Lighting and Power Company to the Consolidated Lighting Company, whereby the latter concern becomes one of the largest of its kind in New England. The price paid is said to be over $300,000. By the transaction, the Consolidated company acquires the plant at Middlesex Narrows, and all the lighting and power contracts in Montpelier, Middlesex, Barre, Williamstown, East Barre, South Barre, Graniteville and Waterbury. The combined power of the two plants will give the Consolidated company a total of 10,100 horse-power.

REDDING, CAL.—Articles of incorporation of the Northern Light and Power Company have been filed with the secretary of state. This company has the right to 4,000 inches of water from Old Cow creek, South Cow creek and Mill creek. Two power plants will be built, both on South Cow creek, five miles apart, capable of generating 7,000 horse-power. The power-houses will be about twenty-five miles east of Redding. The directors of the company are: A. F Smith and A. W. Smith, of Shingletown; William Menzel and T. H. Benton, of Redding, and W. B. Cahoone, of Red Bluff.

ST. LOUIS, MO.—M. L. Holman, former water commissioner, is making an estimate for the city of the cost of a municipal lighting plant. A short time ago Thomas Carter, supervisor of city lighting, at the request of the board of public improvements, made an elaborate estimate of the cost of a munipical lighting plant. This estimate has been submitted to Engineer Holman. The contract under which the city is lighted at present expires September 1, 1910, both as to electric and gas lights. The plan of the board of public improvements is to advertise a new letting and take bids for the next contract. The term proposed is to be twenty years.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company has elected the following officers: Daniel McCool, president; McGeorge Bundy, vice-president; Thomas F. Bechtel, secretary and treasurer; A. F. Walker, general superintendent. The above officers, with the following, will constitute the board of directors: Harvey J. Hollister, Clay H. Hollister, H. N. Higinbotham, E. R. Coffin, George C. Peirce, G. Becker, E. K. McLaren. The business of the company during the past year shows a very satisfactory increase. The earnings have been expended for necessary reconstruction and betterment of equipment to take care of the growing demand for electric service.

TELEPHONE AND TELEGRAPH.

CAIRO, ILL.—The Bell Telephone Company is building a line to Mounds.

MERCER, PA.—The Bell Telephone Company is running a line from New Lebanon to Utica.

LUDLOW, MASS.—The New England Telephone and Telegraph Company will install a new switchboard in the Ludlow central office. The apparatus, when placed in position, will double the capacity of the switchboard now in use.

JACKSON, MICH.—The Farmers' Mutual Telephone Company, of Sandstone, has filed articles of incorporation with the county clerk with a capital of $450. The capital stock is divided into eighteen shares of $25 each. The directors are E. J. Fenn, W. A. Granger and James Mulvaney. The stockholders are the above and Frederick Couling.

DETROIT, MICH.—The gross earnings of the Michigan State Telephone Company for the year ended November 30 amounted to $2,621,349, which compares with $2,293,552 for the year ended December 31, 1905. Operating expenses absorbed $1,964,678, or seventy-four per cent of gross earnings, leaving a balance for net earnings of $656,671.

DAVENPORT, WASH.—H. W. Knopp, of Davenport, Wash., has sold the telephone line from Davenport, Wash., to Fruitland, Wash., and the Deer Trail line, *via* Miles, Wash., to M. R. Nichols. The line between Miles and Latt, along the Spokane river, has been purchased by A. E. Lewis and C. L. DeTilbon, and will be known as the Spokane River telephone line. It connects with the Farm & City Telephone system at Miles.

READING, PA.—It is said that the Philadelphia & Reading Railway in the near future intends extending its telephone system so that it will be possible to reach every station on its system. The company now has a trunk line running between Philadelphia and Pottsville taking in Reading and the principal stations. The system has worked so satisfactorily that there is talk of running additional lines so as to include all of the telegraph offices.

COLFAX, WASH.—The Dry Creek Telephone Company, composed of thirty-six business men of Colfax, Wash., south of Spokane, will make application to the board of commissioners in a short time for a franchise to operate telephone lines along certain highways, connecting with the Pacific States telephone lines. The company was formed three years ago. The Pacific States Company rented receivers to the members of the lines with privilege of connecting with the central switchboard. The three lines, which touch Glenwood and Thornton upon the north, cover 150 miles and tap a thickly settled district.

SENECA FALLS, N. Y.—An investigation instituted by attorneys representing the Empire State Telephone and Telegraph Company in the matter of the request of the village board of trustees that six free telephones be furnished the village departments has brought out the fact that during all the years the company has been doing business in this village it has operated without a franchise. At a meeting of the village board of trustees held July 23, 1880, the board instructed the village attorney to draw a franchise, but this was never done. The company will now seek to have the matter adjusted.

BOSTON, MASS.—According to statistics recently compiled, no section of the country showed more remarkable telephone growth in 1906 than New England. An increase of 24.2 per cent was made by the New England Telephone and Telegraph Company's system, which covers Massachusetts, Maine, New Hampshire and Vermont; so that at the beginning of the year the subscribers connected had reached the total of 253,268. In the western division of the New England system, which includes North Adams, the number of subscribers on January 1, 1907, was 24,692. This represented a gain of 5,310 subscribers throughout the division for 1906.

PERSONAL MENTION.

MR. ARTHUR JONES, president of the Arthur Jones Company, Chicago, Ill., has been in several eastern cities during the past ten days.

MR. WILLIAM H. MARINAN, formerly assistant superintendent of the railroad department of the Elmira (N. Y.) Water, Light and Railroad Company, and who resigned last spring to become general manager of the street car system connecting Fredonia, Brocton and Dunkirk, has severed his connection with this company. Mr. Marinan will engage in the iron business.

MR. FINDLAY S. DOUGLAS has been appointed manager of the motor and generator sales of the New York office of the Sprague Electric Company. Mr. Douglas has been connected with the sales department of the Sprague Electric Company for a number of years. Aside from his extensive acquaintance in the electrical field, he has also an international reputation as an amateur golfer, having held the title of amateur champion of the United States.

MR. H. J. CLARK, of Fort Dodge, Iowa, has been appointed general superintendent of the Citizens' Railway and Light Company, Muscatine, Iowa, succeeding Frederick Potvin, who goes to the main office of the company at Grand Rapids, Mich. Mr. Clark for some time past. Mr. Mershon does not contemplate visiting Fort Dodge (Iowa) Light and Power Company, and previously was connected with the Metropolitan system, New York city.

MR. RALPH D. MERSHON sailed Saturday, February 16, for London, England, to take up there matters relative to the Victoria Falls power scheme, in connection with which he has been retained for some time past. Mr. Mershon does not contemplate visiting South Africa at this time in connection with this work. His present trip will not extend beyond London, Paris and Berlin, and his absence from this country will be limited to about thirty days.

MR. T. R. GENTRY has been appointed manager of the Tuscaloosa (Ala.) exchange of the Southern Bell Telephone Company. Mr. Gentry is the son of W. T. Gentry, general manager of the company. He entered the auditing department at Atlanta, Ga., three years ago, and was soon appointed manager of the exchange at Asheville, N. C. Last December he was made assistant manager to L. C. Oliver, who has charge of the Charleston (S. C.) territory.

MR. CLYDE M. GRAVES has been appointed general manager of the Coeur d'Alene & Spokane Railway, *vice* R. F. Blackwell, resigned. Mr. Blackwell's resignation will not take effect until some time in March, when Mr. Graves will assume the management. Mr. Blackwell was one of the original incorporators and builders of the Coeur d'Alene line, and has been its general manager since its inception three years ago. He leaves the road to devote his entire time to his lumber interests. Mr. Graves will continue in his present position as general manager of the Spokane Traction Company after assuming the management of the Coeur d'Alene division next month.

MR. S. W. CHILDS has been placed in charge of construction on the Tri-City work which is being undertaken by J. G. White & Company at Rock Island, Ill. Mr. Childs has completed the work of electrifying the Fort Dodge, Des Moines & Southern Railroad, and has been located at Boone, Iowa, for the past nine months. Under his direction a power-house and substations have been constructed at Frazer, Iowa, and forty miles of overhead line and track have been built. The gas and electric lighting plants and street railways at Moline, Rock Island and Davenport, are being reconstructed at a cost of $2,225,000, and the entire work has been placed in charge of Mr. Childs.

ELECTRICAL SECURITIES.

There was a continuation of the recovery in prices during the week, and many gains were made, some of these being of good proportions. Dealings, however, were mainly of a professional character. General sentiment is confident, but the lack of interest on the part of the buying public had led to an attitude of caution and conservatism so far as the hopes for an immediate bull campaign are concerned. Some authorities hold that what is needed is a significant development which will give the market the necessary impetus for a decisive movement one way or the other. The money market exhibited a firmer tone with smaller offerings of time funds. Call rates, however, were not above those of the previous week. There has been some falling off in the iron and steel demand, and railroad earnings have not made a particularly good showing.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 16.

New York:	*Closing.*
Allis-Chalmers common	14½
Allis-Chalmers preferred	37
Brooklyn Rapid Transit	75
Consolidated Gas	138
General Electric	159¾
Interborough-Metropolitan common	34¾
Interborough-Metropolitan preferred	71½
Kings County Electric	140
Mackay Companies (Postal Telegraph and Cables) common	74
Mackay Companies (Postal Telegraph and Cables) preferred	70⅛
Manhattan Elevated	143½
Metropolitan Street Railway	104
New York & New Jersey Telephone	114¼
Western Union	82½
Westinghouse Manufacturing Company	150

The annual meeting of the New York & New Jersey Telephone Company will be held February 23 at 12 o'clock at 81 Willoughby street, Brooklyn, N. Y.

The Kings County Electric Light and Power Company has declared the regular quarterly dividend of 2 per cent, payable March 1. Books closed February 19 and will reopen March 1. The annual report of the Kings County Electric Light and Power Company for the year ending December 31 shows receipts of $580,576. against $437,872 for the previous year. Other income brought the total up to $629,026, an increase over 1905 of $144,396. The payment of $592,000 in dividends, against $400,000 disbursed for this purpose in 1905, left a surplus for the year of $37,026, against the previous year's surplus of $74,630. The total surplus on December 31 was $1,159,360.

The Interborough Rapid Transit Company reports for the December quarter as follows: gross earnings, $5,815,232; operating expenses, $2,365,166, leaving net earnings of $3,450,666. Other income brought the total to $3,644,722. The fixed charges amounted to $2,472,806, leaving a surplus for the quarter of $1,171,816.

At the annual meeting of the Mackay Companies the board of trustees was increased from five to seven. The retiring five were reelected as follows: Clarence H. Mackay, William W. Cook, George G. Ward, Dumont Clarke, Edward C. Platt. The two additional trustees are Pliny Fisk and R. A. Smith. Mr. Fisk is the head of the banking house of Harvey Fisk & Son. Mr. Smith is a member of the banking house of Osler & Hammond, of Toronto, Canada. Mr. Smith represents the Canadian interests in the company.

Boston:	*Closing.*
American Telephone and Telegraph	128
Edison Electric Illuminating	225
Massachusetts Electric	68
New England Telephone	122
Western Telephone and Telegraph preferred	77

Philadelphia:	*Closing.*
Electric Company of America	10⅛
Electric Storage Battery common	63
Electric Storage Battery preferred	63
Philadelphia Electric	8½
Philadelphia Rapid Transit	21⅛
United Gas Improvement	94¼

Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	141
Metropolitan Elevated preferred	70
National Carbon common	81
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

ELECTRIC RAILWAYS.

BOSTON, MASS.—The railroad commissioners have authorized the Lowell & Fitchburg Street Railway Company to issue $75,000 five per cent twenty-year bonds to take up floating debt incurred by additions to its property.

BOSTON, MASS.—The railroad commissioners have authorized the Lexington & Boston Street Railway Company, controlled by the Boston Suburban Electric Companies, to act as a common carrier of freight and baggage in the town of Concord, Mass.

DANSVILLE, N. Y.—A company has been organized in New York city to build a new electric road between Dansville and Hornell, and incorporation papers have been filed at Albany. Ten per cent of the capital stock of $100,000 has been paid in. The persons financially interested are all New Yorkers.

JAMESTOWN, N. Y.—President A. N. Broadhead, of the Jamestown Street Railway and Chautauqua Traction Company, is said to be interested in a proposed new trolley line to connect Jamestown and Dunkirk. It is understood that the new line will touch Gerry, Sinclairville, Stockton, Lily Dale and Fredonia.

DURANGO, COL.—The Durango & Pine River Railroad Company has been incorporated by eastern capitalists for the purpose of building an electric railway from Durango thirty miles to the rich farming regions on the Florida and Pine rivers. The new company is capitalized for $400,000, and all the stock, it is stated, has already been taken up. Electric power to operate the proposed road will be generated from the water of the Pine river.

MARION, IND.—The Grant, Miami, Cass & Western Interurban Company is the name of a new interurban which will be constructed on an air line between Marion and Logansport. The road will be forty miles in length and will touch twelve towns, including Marion, Sweetser, Mier, Converse, Bunker Hill, Amboy and Logansport. The names of the stockholders are not made public at this time. All of the right of way has been purchased and the road has been financed.

LOUISVILLE, KY.—Having obtained from the Louisville Railway Company its promise to extend its tracks to Orel, the incorporators of the Kentucky Traction Company, who are Charles G. Dehler, F. Joseph Herrman, H. S. McNutt, Frank Senn, J. Ackerman, John F. Kellner and William Weller, have turned over their franchise to the railway company. The incorporators of the Kentucky Traction Company own summer homes and farms in the vicinity of Orel.

COLORADO SPRINGS, COL.—The promoters of the proposed electric line between Colorado Springs and Denver and its probable extension to Pueblo, Cripple Creek, Canon City, Greeley and other towns have drafted an ordinance asking for a franchise. The ordinance provides that work shall be started within a year and that the road shall be completed within two years after beginning work. E. R. Stark, of Colorado Springs, is back of the project. Denver and St. Louis capitalists are interested.

NAPA, CAL.—Articles of incorporation of the Napa & Vaca Valley Railway Company have been filed with the county clerk, showing the proposed route of the new road from Vallejo to Vacaville. From Vallejo the line will run to Napa Junction, thence to Soscol, six miles below this city, where it will turn to the east and passing through Cordell will go on to Vacaville. D. A. Dunlap, E. H. Winship and H. M. Meacham are behind the project and have already subscribed $30,000. The capital stock is given as $500,000.

CANON CITY, COL.—The city council has awarded a franchise to Frank D. Heath and associates, granting rights of way for constructing and operating an electric street railway in Canon City to the top of the Royal Gorge, and to the City park, recently set aside by act of Congress for the benefit of Canon City. About twelve miles of road will be constructed to the Royal Gorge park and ten miles within the city. The enterprise will entail an outlay of approximately $400,000. The franchise runs for twenty-five years and calls for the completion of the road by January 1, 1908.

SPRINGFIELD, OHIO—It is announced that the work of constructing the traction line from this city to Cincinnati by way of Wilmington, Clarksburg and Norwood will be commenced as soon as the weather permits. Practically all of the right of way has been secured. The Springfield, Wilmington & Cincinnati Traction Company, which will operate the line, has sold $4,000,000 worth of bonds to English capitalists, and the material has been purchased. The road will be seventy-two miles in length, and cars will make the trip in two hours. A branch will be built from the main line at Cedarville to Xenia.

WHEELING, W. VA.—At a meeting of the directors of the Dillonvale & Ohio River Traction Company it was decided to construct a road from Rayland to Dillonvale. The new line will be six and a half miles in length, and the work of construction will be done by T. J. Stringer. The road will connect Dillonvale with the river front at Rayland, where the new line will connect with the Wheeling Traction Company's new line just completed to Rayland. The directors organized as follows: president, T. J. Stringer, of Rayland; vice-president, J. T. Hodgens, of Rayland; secretary and attorney, W. B. Francis, of Martins Ferry; treasurer, Louis Lipphardt, of Martins Ferry.

GRAND RAPIDS, MICH.—The Grand Rapids Street Railway Company at its annual meeting reelected the old officers and the same directors, with the substitution of Jacob Kleinhans for Anton Hodenpyl, whose other business interests prevented his serving again. The officers are: president, C. M. Clark, Philadelphia; vice-president, Lester J. Rindge, general manager, secretary and treasurer, Benjamin S. Hanchett; assistant secretary, C. Ford Stevens, Philadelphia. The directors are: C. M. Clark, Philadelphia; Lester J. Rindge, Jacob Kleinhans, William H. Anderson, John A. Covode, Thomas F. Carroll, William Judson, Benjamin S. Hanchett and J. Boyd Pantlind, all of Grand Rapids.

NEW MANUFACTURING COMPANIES.

TRUMANSBURG, N. Y.—The Electric Fittings Company has been incorporated at Albany with a capital of $125,000.

AUGUSTA, ME.—The Offenheimer Electric Company, has been organized at Augusta for the purpose of manufacturing electrical apparatus, with $500,000 capital stock, of which nothing is paid in. The president and treasurer is J. Berry, of Augusta.

CINCINNATI, OHIO—F. S. Davis and H. P. Brown, of Ludlow, Ky., and F. A. Hilckmann, of Cincinnati, have organized the Automatic Electrical Brake Control Company. The capital stock is fixed at $20,000, and the principal place of business is Ludlow.

DATES AHEAD.

Underwriters' National Electric Association. Annual meeting Electrical Committee, New York city, March 27-28.

Ohio Independent Telephone Association. Annual convention, Columbus, Ohio, March 28.

Iowa Electrical Association and Iowa Street and Interurban Railway Association. Clinton, Iowa, April 18, 19 and 20.

Southwestern Gas, Electric and Street Railway Association. San Antonio, Texas, April 18-21.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

Railway Telegraph Superintendents' Association. Annual meeting, Atlantic City, N. J., June 19-20.

OBITUARY NOTE.

MR. JAMES BLAKE CAHOON died at his home in New Rochelle, N. Y., on Sunday, February 17, aged fifty years. Mr. Cahoon was very well known throughout the electrical field. He was born in Linden, Vt., and was graduated from the United States Naval Academy at Annapolis in 1879, and from the United States Torpedo School at Newport, R. I., in 1885, taking there the post-graduate course in electricity. In 1889 he became manager of the "expert" department of the Thomson-Houston Company, Lynn, Mass., and in 1895 was made general manager of the electric light, gas, water and street railway companies of Elmira, N. Y., remaining in this position until 1899. Since that time he practiced in New York city as a consulting engineer. Mr. Cahoon designed and built the new electric light station at Syracuse, N. Y., and was at one time vice-president of the Oneida (N. Y.) Light and Power Company. During the Spanish-American War he served as a volunteer, and was given honorable mention for excellent service. Mr. Cahoon was president of the National Electric Light Association, 1900-1901. He is survived by a widow and two children.

INDUSTRIAL ITEMS.

THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, Boston, Mass., has ready for distribution a handsome catalogue devoted to an illustrated description of the Anderson electric time switch. This catalogue will be sent to any one interested upon request.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., is distributing some attractive literature devoted to its brushes and washers for car-cleaning and street railway service. The company will be pleased to send descriptive matter and price lists upon application.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., in catalogue No. 1, describes and illustrates its line of electric light specialties. Among the more important are "Ajax" pole tops, mast arms, high-voltage insulators, arc hoods, pole fixtures, rainproof rope and swivel pulleys. This catalogue will be sent to any one interested upon request.

WENDELL & MACDUFFIE, 26 Cortlandt street, New York city, has published catalogue No. 16, devoted to its reenforced asbestos corrugated sheathing and fireproof building material. A discount sheet has also been published, and a folder in two colors devoted to "Century" asbestos shingles. Any of this literature may be secured from the company upon request.

THE NORTHERN ELECTRIC AND MACHINE COMPANY, 22 Brooklyn avenue, Brooklyn, N. Y., announces that it now has a complete line of creosoted pole line materials, embracing creosoted poles, cross-arms, pins, brackets and pole steps, having completed its line by taking the creosoted pin and bracket output of the M. P. Osborn & Sons Company, of Camden, N. Y.

CHARLES E. DUSTIN & COMPANY, 11 Broadway, New York city, has published a new catalogue of electrical and steam machinery for central stations, street railways and isolated plants. The company deals in electrical, steam and miscellaneous machinery of every description, and carries a large stock of electric generators, steam engines, boilers, pumps, etc. It has ample storage facilities and is prepared at all times to purchase complete plants and machine equipments.

THE H. O. S. ENGINEERING COMPANY, Newark, N. J., has increased its shop facilities by taking a place at 216-226 High street, in addition to its old factory at 16-22 Boyden place. The additional shop doubles its space, and it will be in a position to execute orders more promptly than before. The company has also added to its line of switchboards and panelboards a line of enclosed and flame arc lamps. In this line it has been very successful.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has let a contract to the Berlin Construction Company, Berlin, Ct., for building an extension to the Economizer company's fan shop. This company has recently experienced a very heavy demand for fans, and this addition will enable it to more than double its present output. A shop has also been put up exclusively for manufacturing the new patent Green steam and hot water heating coil. The pressure of business in these lines, and also in the manufacture of fuel economizers, has compelled the Green Fuel Economizer Company to acquire for building purposes several acres of land adjacent to its present property.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has opened a new branch office at 214 Main street, Buffalo, N. Y. This branch consists of a large retail office and warerooms, and will be under the management of George A. Schmidt, who for a number of years was connected with the Manville Covering Company, Milwaukee, which company is now a part of the H. W. Johns-Manville Company. Mr. Schmidt is well known throughout the Buffalo section, having, until recently, been in charge of a special department of the W. A. Case & Sons Manufacturing Company, Buffalo, which company until recently, was the Buffalo agent for the H. W. Johns-Manville Company. B. F. Boscoe has been appointed assistant manager of this branch, and will make his headquarters in Rochester. Harry V. Patton, formerly manager for a local asbestos house, will also be associated with the new Buffalo branch.

Record of Electrical Patents.

Week of February 12.

843,621. ELECTRIC TIMING DEVICE. Hervey H. McIntire, South Bend, Ind. An adjustable programme clock.

843,703. RAILWAY SIGNAL SYSTEM. Alfred L. Ruthven, Topeka, Kan. A danger-signal system operated by overlapping contact conductors.

843,730. LOCKING DEVICE FOR DOORS AND WINDOWS. Josef Wittmann, Munich, Germany. A spring catch on the bolt is withdrawn by an electromagnet.

843,731. ARRANGEMENT FOR REGULATION OF SPEED OF COMPENSATED SINGLE-PHASE MOTORS. Engelbert Arnold, Karlsruhe, Germany, and Jens Lassen la Cour, Edinburgh, Scotland. An induction regulator for starting and speed-regulating is combined with a single-phase compensated motor.

843,733. ELECTRIC REGULATOR. Augustus C. Carey, Boston, Mass. A variable resistance consisting of a mass of loose electrically conductive particles.

843,735. STARTING RHEOSTAT. Lewis S. Chapman, Schenectady, N. Y., assignor to General Electric Company. Means are provided for setting free the no-voltage release.

843,739. ELECTRIC INSULATOR. Frederick A. Feigert, Shelbyville, Ind. An outer casing is added having an upper retaining flange and a lower water drip.

843,746. SELECTIVE TRANSMITTING SYSTEM. John L. Hall, Schenectady, N. Y., assignor to General Electric Company. A combination for a plurality of wires and polarized relays.

843,747. METHOD OF PRODUCING LAMINÆ FOR TRANSFORMER CORES. Walter A. Hall, Lynn, Mass., assignor to General Electric Company. A method of stamping U-shaped laminæ.

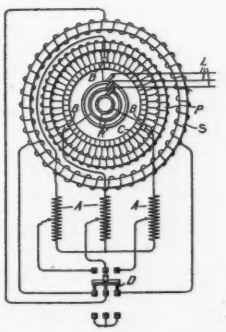
843,749. BRAKE-CONTROL SYSTEM. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. An electrical system for the simultaneous control of independent air-brake equipments.

843,753. STARTING DEVICE FOR ELECTRIC MOTORS. Arthur C. King, Madison, Wis., assignor to Northern Electrical Manufacturing Company. An electromagnet prevents too rapid movement of the controller arm.

843,761. TROLLEY RETRIEVER. Francis M. Miller, Arcadia, Ind. A continuously driven retriever.

843,763. CONNECTOR OR TERMINAL FOR ELECTRICAL CONductors. James McLaughlin, New York, N. Y., assignor to General Electric Company. A wedge-contact for rail-bonds or the like.

843,774. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. There are two members rotated at different speeds, one supplying a low-frequency exciting current to the other.



843,774.—ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE.

843,775. ELECTRIC HEATER. Samuel W. Taliaferro, San Francisco, Cal. The heating is controlled by a thermostatic bar.

843,776. ELECTRIC FURNACE. Edward R. Taylor, Penn Yan, N. Y. Portions of the charge may be passed through a surrounding body to the reaction zone.

843,777. METALLURGICAL PROCESS. Edward R. Taylor, Penn Yan, N. Y. The charge is fed downwardly while a suitable portion passes inwardly to a central reaction zone.

843,788. ELECTRIC LOCOMOTIVE. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Company. Bearing members, attached to the frame, support the motor armatures which are geared to the driving axle.

843,814. MEANS FOR CONTROLLING VALVES OR OTHER MOVABLE DEVICES FROM A DISTANT STATION. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. The operating motor is controlled by a polarized relay.

843,836. ATTACHMENT FOR MOTOR ARMATURES. Joseph W. McManiman, Washington, N. J. The driving gear is loose on the armature shaft, but may be attached to it by a clutch-collar.

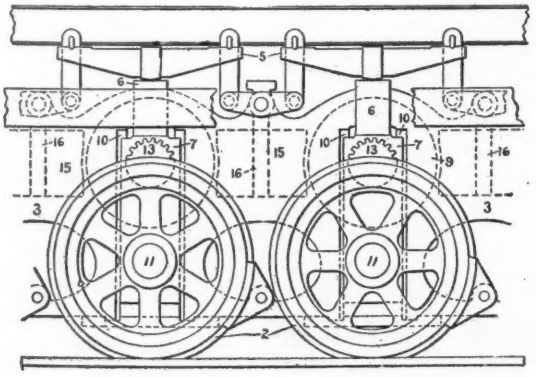
843,844. THIRD-RAIL INSULATOR. Robert N. Redmayne, Newcastle-upon-Tyne, England. The insulator has longitudinal grooves on the top and drip edges at the sides.

843,852. FUSE OR ELECTRIC CUT-OUT. Charles A. Steller, Jr., Jersey City, N. J. An enclosed fuse.

843,871. TELEPHONE TRUNKING SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A method of connecting testing circuits to the trunk.

843,890. CONNECTION FOR ACOUSTICONS. Howell W. Haff, Babylon, N. Y., assignor to Kelley M. Turner, New York, N. Y. A multiple binding-post.

843,891. TELEPHONE RECEIVER. Howell W. Haff, New York, N. Y., assignor to Kelley M. Turner, New York, N. Y. A hand-operated switch is provided.



843,788.—ELECTRIC LOCOMOTIVE.

843,900. ELECTRIC LIGHT BULB. Frank E. Lerberg, Newark, N. J. The bulb is sealed by a hollow glass stem into which an attaching pin is inserted.

843,901. ELECTRIC SWITCH. Herman J. S. Lewis, New York, N. Y., assignor to John H. Dale, New York, N. Y. A multiple contact-switch.

843,902. MULTIPLE ELECTRIC SWITCH. Herman J. S. Lewis, New York, N. Y., assignor to John H. Dale, New York, N. Y. The switch levers are operated by a cam.

843,919. ELECTROMAGNET. John E. Washburn, Egmont, Fla. The core is composed of a series of imperforated discs.

843,930. NON-ARCING MUFFLED FUSE. Frank B. Cook, Chicago, Ill. The fuse is surrounded by asbestos packing.

843,940. ANTISEPTIC GUARD FOR TELEPHONE TRANSMITTERS. Gerhardt E. Grimm, Camden, N. J. A clip of antiseptic paper.

843,998. TELEPHONE HOOK-SWITCH. Charles C. Cadden, Cleveland, Ohio. A method of construction.

844,009. ELECTRIC SYMPATHETIC OR SECONDARY CLOCK FOR INDUCTION CURRENTS. Martin Fischer, Zürich, Switzerland, assignor to Actiengesellschaft, "Magneta," Zürich, Switzerland. The clock is controlled by an electromagnet.

844,010. CLOCK CONTROLLED BY REVERSALS OF ELECTRIC CURRENT. Martin Fischer, Zürich, Switzerland. An escapement driven by a polarized magnet armature.

844,034. COIN-COLLECTOR FOR TELEPHONE LINES. Frank R. McBerty, Evanston, Ill., assignor to Western Electric Company, Chicago, Ill. The disposal of the coin is controlled by a magnet.

844,044. ATTACHMENT PLUG. Johann G. Peterson, Bridgeport, Ct., assignor to the Perkins Electric Switch Manufacturing Company, Bridgeport, Ct. The insulating body contains a metallic socket cut away on one side.

844,045. ELECTRIC SWITCH. James C. Pinkerton, Philadelphia, Pa. A switch operated by fluid pressure.

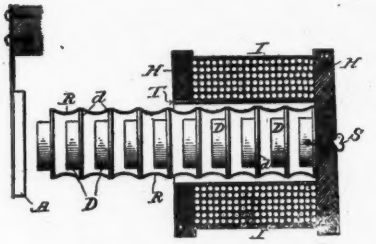
844,074. CHRONOMETRIC CULINARY SYSTEM. Robert S. Woodward, Jr., Washington, D. C. A number of adjustable time alarms are provided.

844,080. ELECTROCAPILLARY APPARATUS. James T. Armstrong and Axel Orling, London, England. A capillary voltmeter.

844,086. TELEGRAPHIC PICTURE-TRANSMITTING MECHANISM. Edouard Belin and Marcel Belin. A number of selenium elements are switched successively into a local circuit.

844,087. ILLUMINATED SIGN. Elmer E. Bellamy, Cleveland, Ohio. An enclosed sign.

844,090. AUTOMATIC END-CELL SWITCH. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. The end-cell switch is operated by fluid pressure.



843,919.—ELECTROMAGNET.

844,126. SOCKET-SEAL FOR ELECTRIC LAMPS, ETC. Llewellyn T. Hatfield, Sacramento, Cal. A seal to prevent opening an incandescent lamp socket.

844,139. INSULATING MATERIAL AND METHOD OF MANUFACTURING SAME. George Kelly, Hinsdale, Ill. Paper, containing printers' ink, is impregnated with a vulcanizing binder.

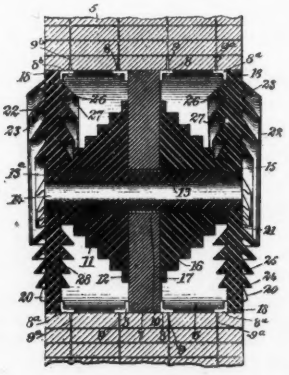
844,140. INSULATING MATERIAL AND METHOD OF MANUFACTURING SAME. George Kelly, Hinsdale, Ill. Insulating material formed from disintegrated paper containing printers' ink.

844,200. CABLE HANGER. Benjamin H. Skinner, Canton, Ohio. A metallic strip hanger which passes twice around the cable.

844,208. INSULATOR FOR LEADING-IN CABLES, ETC. Louis Steinberger, New York, N. Y. A series of corrugated, truncated cones of insulating material, pierced by an insulating tube.

844,213. ILLUMINANT FOR INCANDESCENT ELECTRIC LAMPS. Orlando M. Thowless, Newark, N. J. The glower material is structurally solid, non-porous and vitrified, and is a non-conductor of ordinary temperatures.

844,240. INDUCTION COIL. Clinton L. Bopp, Hawkeye, Iowa, assignor of one-fourth to John Beal, Whittier, Cal. Two sources of current are provided, one for operating the vibrator and one for generating the high-tension discharges.



844,208.—INSULATOR FOR LEADING-IN CABLES.

844,257. HARMONIC SIGNALING FOR POLYSTATION TELEPHONE LINES. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. The signal-receiving devices are tuned to given frequencies, the running current being regulated to prevent interference.

844,278. TELEGRAPH KEY. John J. Ghegan, Newark, N. J. The wire connectors are imbedded in a base of plastic insulating material.

844,299. ATTACHMENT FOR TELEPHONE RECEIVERS. James R. Challen, Collegeville, Pa. The receiver cap is provided with an elastic dome-shaped cap.

844,300. PROCESS OF NEUTRALIZING STATIC ELECTRICITY. William H. Chapman, Portland, Me., assignor to Chapman Electric Neutralizer Company, Portland, Me. Air, oppositely charged, is blown against the charged material.